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NEW YORK, SATURDAY, MAY 2, 1908.

CONTENTS.

Editorial ..... 887
Iowa Electrical Association Convention..... 892
Committees of the Underwriters' National Electric Association..... 892
Missouri Electric Light Convention..... 893
International Acheson Graphite Company Improvements..... 894
Japanese Electrical Science Association..... 894
Convention of the Southwestern Electrical and Gas Association..... 894
Daylight and Artificial Light..... 894
May Meeting of the A. S. M. E..... 894
Tests of Fuels for Producer Gas Plants..... 895
German Wireless Rates..... 895
Side Lights on the Fuel Problem..... 895
Death of the Oldest Telephone Manufacturer..... 896
Electric Gas Apparatus..... 897
Current News and Notes..... 897
Distribution of Niagara Energy in Auburn..... 899
Capitalization of Public Utilities. By Chas. M. Brown..... 903
Central Station Notes from Atlanta..... 904
Electrical Developments at Chattanooga, Tenn..... 905
Direct-Current Motors—Their Action and Control. VII. By F. B. Crocker and M. Arendt..... 906
The Choice of Transformers for Central Stations. By L. A. Starrett 908
Electrically Operated Switchboards. II. By S. Q. Hayes..... 909
Subway and Cable Records for Electric Light Companies. By Charles Holmberg..... 913
Electric Wiring of New and Old Buildings. By J. E. Weis Mandel.. 914
Transformer Testing. By W. M. Hollis..... 915
Construction of a Spark Coil. By F. C. Mason..... 916
Automatic Damper Regulators. By W. H. Wakeman..... 917
Letters on Practical Subjects..... 920
Questions and Answers..... 925
Central Station Publicity. By Andrew J. Haire, Jr..... 926
The Advantages of Electric Drive for Textile Mill Equipments. By Norman G. Meade..... 928
Concentrated Effort in Central-Station Advertising. By J. O. Little 929
New Business in Jersey City, N. J. By William H. Stuart..... 930
LETTERS TO THE EDITORS:
Ice Storms in Georgia. By F. P. Catchings..... 931
Digest of Current Electrical Literature..... 932
Mercury-Vapor Lamps in Silk Mills..... 937
Gas Engine for Driving Generator in Steel Mill..... 938
Mercury Arc Rectifier in Moving Picture Shows..... 939
Remote Control Switch..... 940
Circuit Breakers for Low-Tension Alternating-Current Circuits..... 940
Double-Magnet, Quick-Break Switch for Remote Control..... 941
Sewage Pumping Stations at Dayton, Ohio..... 942
Additions to D. L. & W. Shop and Mine Electrical Equipment..... 942
Industrial and Commercial News..... 943
General News..... 947

### FIVE THOUSAND CENTRAL-STATION SYSTEMS.

The central-station industry in this country has signalized the month of April by passing the high watermark of 5000 companies. In other words, the total for the end of March was 5015, and as the number grows on the average about 10 per week, it is perfectly safe to take 5000 as the present irreducible minimum. The mere number gives an impressive idea of the growth of the industry, especially when coupled with the statement that the capitalization is at least $1,000,000,000. The number in 1902 was 3620, which would give an average yearly gain up to the end of 1907 of 275. The gross gain in the past 12 months has been 485, but there is, of course, a constant tendency to diminish this gross owing to consolidations, so that in large cities and large areas one company exists where possibly a score were previously in independent operation. It is interesting to note the distribution of these companies and plants, many of which are, of course, under municipal ownership. The largest number is in Illinois, which has 419, while New York has 345 and Pennsylvania 331. Ohio has no fewer than 282, but Texas has the surprising number of 221 or more than Indiana with 210 and nearly as many as Michigan with 247. Oklahoma shows up already with 63. During the past year, Illinois has gained 20 net, but New York has gained no fewer than 30, showing that the Public Service law has been no check to enterprise. In other cases large gains have apparently been made, but they are often statistical rather than real, some of the plants having been already in existence but not brought to account before. The drop in the cost of copper seems to have been a decided stimulus.

Another notable feature is the extent to which the central-station companies carry lines of electrical supplies. It appears that of the 5015 companies and plants, the large number of 2698, or more than half, are thus in the supply business; but there are interesting variations in this respect. For example, of the 345 New York companies only 140 carry supplies, but in Illinois 254 of the 419 do so. In Iowa 143 out of 203 make this a practice, in Texas 135 out of 221, and in Wisconsin 123 out of 186. This would imply a certain lack of supply and wiring firms in the various localities, and doubtless has its justification in other respects. Such a close relation to the consumer and the market would imply an ability to control new conditions and to keep a firm finger on prices and the pulse of the market. All told, in the United States, Mexico, Canada and the West Indies there are now 5464 companies or systems, of which 449 are outside this country. The National Electric Light Association should derive much encouragement from these figures, for large as its membership actually is, it has evidently plenty of room for growth. Probably it will never have all the companies in membership, but it may reasonably expect to have ultimately 50 per cent of the private companies within its organization—say, 2500 company memberships. With that number it would exert an even greater influence than it does to-day

on the art, and its policies would become irresistible. The Association has other elements of membership, but must obviously be based upon the central station companies to promote whose welfare and to protect whose interests it was created. On the other hand, we venture to suggest to some of these numerous new companies not over well acquainted with the history of the lighting art and of the Association, that they could not do a better or more profitable thing than to join the organization and attend the Chicago convention now so near at hand.

## The Iowa and Missouri Conventions.

The State electric light conventions of Iowa and Missouri, held last week, are briefly reported elsewhere in this issue. At the present time, when new developments are rapidly taking place in the central station field, the advance of the art as noted in the few months' interval between one State convention and another is sometimes rather startling. When it is considered that the beginning of 1908 marked the first real introduction of American-made tungsten lamps on the market and that up to that time the tungsten lamp was not a factor in small central stations, it is remarkable to note how many small companies reported practical experience with them at last week's conventions.

The 75,000 tungsten lamps reported as sold by one of the two commercial American tungsten lamp factories during the past few months, together with the products of the other factory, seem to have been well scattered over the country and to have been made good use of by central station men in driving out gas and gasoline competition and in retaining dissatisfied customers. It is also significant that a considerable percentage of the tungsten lamps have been shipped to small dealers and contractors who usually sell only a few lamps. Evidently these dealers are losing no time in pointing out to the user how much he can gain by installing tungsten lamps. Moreover, it is of value to note that in some cases the lowering of a consumer's maximum demand by the use of tungsten lamps has been accompanied by increased consumption at other than peak periods so that the bills remain the same, the consumption being spread over more hours per day. This change is certainly one earnestly to be desired by the central station man, for it means better net earnings per dollar invested.

At both conventions the possibility of vacuum cleaning becoming a good source of day load came up. In most of the small towns of Iowa and Missouri the prospect of supplying energy to many stationary outfits of this kind is not alluring because there are few if any in a small town that can afford them. Some of the enterprising managers of small companies, however, are thinking of purchasing portable, electrically-driven, vacuum-cleaning machines and renting them to men who do carpet cleaning in the town for use in houses where electrical energy is available. Such a plan seems entirely feasible. It will provide not only a constant source of revenue, but an excellent standing inducement to householders to adopt electricity. In connection with day loads in small towns it is observable that the consensus of opinion places the minimum size of town where a 24-hour service can be made to pay much lower than formerly, several maintaining that in a town having a population of 1500 or more, a "day circuit" can usually be made worth while.

## The Long-Distance Transmission Record.

Niagara as a source of power is gradually coming into its own. Despite its enormous resources and its early development, the energy of Niagara was for a long time distributed over very moderate distances, and as a whole the plants about the great cataract have lately contributed very little that is striking to the progress of the art. The time has come, however, when the long lines have begun to appear and from now on they are likely to stretch further and further. The supply over 163 miles nearly straightaway is, as our description indicates, probably the longest 24-hour-a-day transmission yet in use, although it is so far surpassed in length by the great California lines, as frequently connected and used, that its victory is open to the imputation of being a barren one. Still it is a great record from any point of view. The Auburn branch of the great system takes the main line energy at 60,000 volts and diverts it to the existing Auburn station in which the necessary reducing and converting apparatus is located. It is one of the many cases in which one instinctively raises the question of the great inconvenience of the low periodicity of the Niagara plant, since frequency changers must have and elsewhere form part of the equipment. Despite the often made proclamations of earlier days that the 25 gave successful incandescent lighting, it is noticeable that few companies have had the temerity to try it, and the modern high-efficiency incandescents make it doubly inexpedient.. Still, on a long line a frequency changer is not an unmixed evil, since if worked by a synchronous motor it gives a good chance for holding the power factor to a good value.

The system of purchasing power on a one-minute peak basis leads to the very free use of the old steam equipment during the peak period. It would be interesting to know the exact effect of this on the cost of energy. Auburn, being one of the few places where central plants heating from exhaust steam is carried on by the electricity supply company, is in better condition than most places with respect to this peak requirement. The problem of equitable rates in this wholesale supply of power from transmission systems is a very knotty one.. The standby charges become a serious item in the costs to ordinary stations, while they are likely to be a very important consideration in the plans of the transmitting company. Unless the latter protects itself pretty thoroughly in this respect, the distributing company will be under stronger temptation to take on much short-hour business which it would dodge were it running its own steam plant single handed. Looking at the matter from the other side, there is always a question whether the generating company actually does hold the reserve capacity on which it is collecting standby charges, the temptation being to sell it several times over and take chances on getting caught short of power when no good excuse is available. There is this element of illusion in the standby charge proposition which it is difficult to eliminate. How many supply companies actually keep themselves in position to deliver simultaneously all the capacity-peaks for which they are theoretically receiving payment? Some, undoubtedly, but by no means all. From any point of view, the policy of the Auburn local company in keeping down its peak demand is a sensible one. Its substation plant, considering the service, is a comparatively simple one and the switchboard in particular lacks the complication that has become altogether too common in recent

plants. When the switchboard becomes a serious item in the plant, it is time not to mourn the complicated requirements of modern service, but to get down to the simple life. This whole long transmission from Niagara, by the way, is to be commended for its comparatively simple equipment. It is only by adopting simple and economical methods that long distance transmission can fulfill its destiny. Niagara, to be interlinked probably with other sources of power, is just fairly started upon its larger field, and has enormous possibilities before it.

## ECONOMICAL PRESSURES FOR POWER TRANSMISSION BY UNDERGROUND CABLE.

The question of how high a voltage should be used in transmission is to-day answered easily enough for distances not exceeding 50 miles, and for an overhead pole line, i. e., for transmission over air-insulated conductors. In such cases we do not require to employ pressures above 50 kilovolts, and the line insulators, as well as the line transformers, are of standard types. The only drawback to aerial transmission is atmospheric electric disturbance, i. e., lightning troubles. As long as we have transmission wires above ground, so long must we expect to suffer trouble and inconvenience from *Jupiter tonans*. However, this difficulty tends to diminish steadily as experience increases with various constructions and devices for lightning protection. When, however, the conditions of occupation and development of the land over which power has to be transmitted are such as to make underground cables worth discussing, as for example when transmitting power over a thickly-settled town and city district, the question of how high a voltage should be used is more difficult to answer. The factor of safety required from the cable has to be carefully considered, and the expense of the cable increases rapidly with this factor of safety. The difficulty, delay and expense in repairing accidents to buried cables will be much greater than in the case of wires above ground. The only advantages are freedom from atmospheric disturbances and freedom from danger of accidental contact, injury to persons or property, or of interference, accidental or otherwise, by the actions of individuals, such as shooting at line insulators or short circuits, due to objects thrown across the wires.

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The selection of the most economical conductor for the transmission of direct currents is relatively simple, and the rule governing this case was enunciated by Lord Kelvin long ago. When alternating current transmission is employed the rule requires modification, because the waste of power in transmission is not limited to $I^2R$ loss. There is in addition a loss due to $E^2G$, produced by dielectric hysteresis or imperfect electric elasticity in the insulator. This loss increases as the square of the voltage and occurs at all hours of the day and night, whereas the copper loss disappears as the load disappears. In some high-tension cables the annual dialectric loss of energy in kw-hours considerably exceeds the annual copper loss. It is easy to show that once a cable has been purchased and laid, the most economical voltage to employ, with respect to power saving, in transmitting a given annual amount of energy over it, is such that the dielectric and copper losses are equal, provided, of course, that this voltage does not cause either the dielectric or the copper to be unduly stressed and heated.

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An article on the economical pressures for underground power cables, by Mr. J. B. Sparks, has recently appeared in London *Electrical Engineering* and is abstracted in the Digest. This article confines its inquiry to copper losses and leaves the consideration of dielectric losses in reserve as a clinching argument for the main proposition. The proposition is that it will rarely pay to use cables for pressures between conductors exceeding 25 kilovolts. Curves and tables are produced which show that in the particular case of a 31-mile transmission of 50 million kw-hours per annum by underground cable, it would be more economical to select a cable for 25 kilovolts, than to use a higher pressure and a correspondingly more expensive cable.

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In practice, the question does not usually present itself in this form. When power has to be carried to a considerable distance, it is usually from some big waterfall to a big city. The waterfall is usually situated in a comparative wilderness, where it would be a sin and shame to put the high-tension transmission wires underground. Consequently, overhead transmission lines are erected and carried to city limits, where it becomes necessary to go underground in order to reach the high-tension receiving station at which distribution commences. Then the question arises, should a high-tension cable be used so as to go underground at full pressure; or should a transformer station be placed at the city limit to reduce the pressure to an intermediate value between that of transmission and that of distribution? In answering such a question, much will depend on local conditions, and no rigid rule can be prescribed. Among the determining factors will be the magnitude of the transmission pressure on the aerial line, the length of city cable required, the frequency of atmospheric electric disturbances, etc. The article above referred to indicates that on the Moutiers-Lyon 112-mile overhead transmission line using a direct-current, 60-kilovolt system for transmission, and an alternating distributing system, the last three miles are underground, and employ 60-kilovolt, direct-current cables. Under such conditions, there will always be a demand for high-tension cables.

## MODERN PROTECTIVE DEVICES AGAINST DANGEROUS CURRENTS IN DISTRIBUTING SYSTEMS.

The development of high-tension distributing systems has brought about the introduction of special forms of automatic switches, the duty of which is the cutting out of any defective section as soon as the current flowing into it becomes excessive. This is usually accomplished by automatic time-relays which are set to release oil-switches after a current overload of definite strength has acted unchecked for a definite number of seconds. These time relays are so located and adjusted that the particular branch cable in defect shall be cut out promptly. If it fails to be cut off within a certain prescribed interval, the main conductor supplying it should be disconnected, and finally if that fails to be cut off within a certain greater interval, the high-tension feeder should be disconnected. A long article on this subject (abstracted in the Digest), by Herr Karl Kuhlmann, has recently appeared in the *Elektrotechnische Zeitscrift*, dealing with a variety of conditions in high-tension distributing systems. One of the interesting features of this discussion is the determination of allowance that must be made for the normal charging current of an alternating-current high-tension system. It is necessary that an automatic switch should disconnect a conductor when the load current is dangerously great, but it should not operate by reason of the normal charg-

ing current that flows over the conductor. Some measurements of charging currents on cables at 6000 volts are recorded, for the case of a particular central station, from which it appears that the total length of cable conductors under excitation was some 320 miles, representing a joint capacity of 74 microfarads, and a total charging current of 240 amperes, or 0.8 ampere per mile. This represents a total charging power of 830 kilovolt-amperes, or 2.6 kilovolt-amperes per mile of underground wire. A number of relays are described, together with their method of connection to the circuit and to the disconnecting circuit switches. It is evident from a perusal of the paper that there is plenty of room for invention and design in simplifying and further developing these high-tension automatic devices.

## Trials of the Illuminating Engineer.

Much has been accomplished in the past three years in the way of stirring up interest in the proper design of electric-lighting installations so as to produce good illuminating results from both a commercial and artistic standpoint. If the experiences of those engaged in planning and trying to have carried out work of this kind could be collected together in book form, it should have a large sale among engineers as a work of humor. At the present time, unless the man who designs the illumination watches the job at every stage of the game, it is likely to be unrecognizable as an engineering attempt by the time it is installed. This is largely due to the slipshod conditions surrounding the work of supplying fixtures and glassware in the past. The job must pass through the hands of so many persons after it leaves the designer that the chances for mistake or substitution as well as for wilful tampering with original ideas are very great. Until there is a more general education of fixture makers and hangers, as well as of the owners, it is to be expected that there will continue to be the laughable attempts at illumination which we now see on every hand, even though the original adviser may be fully competent. Matters of detail which sometimes appear very unimportant frequently make considerable difference in illuminating results as well as appearances.

Anyone who has followed the matter closely can doubtless recall cases where a ludicrous appearance has been produced by the use of the wrong shade holders, to say nothing of the illuminating effect being considerably changed from what it should have been, and this in spite of the fact that the most expert advice obtainable had been originally sought. In another case a complete floor of a large building originally planned on the basis of 2 watts per sq. ft. was, by a series of oversights combined with considerable tampering with original designs, finally reduced to 1 watt per sq. ft., when the actual installation was made, giving results which would have been disastrous had not the tungsten lamp appeared on the market about that time. In another case, through an entire building, shade holders, intended for use with Gem lamps, were used only on 16-cp lamps, while all the Gem lamps had common standard shade holders. A specification for show-window lighting recently drawn up called for the lamps to be pointed about 10 deg. from the vertical. The wiring foreman modified this so that when the job was finished concentrating reflectors were found pointed at the top of the show window back, thus giving the greatest intensity where it was least needed. Changes in arrangement of rooms are frequently made after the original lighting plans are drawn, but seldom is the one who draws lighting plans consulted about these changes. The results are frequently ludicrous, appearing either in the shape of absurd location of fixtures or arrangements entirely unsuited to the case in hand. There is only one moral to be drawn from these numerous little incidents, which seem to be the rule rather than the exception where good illuminating work is attempted. If it is a central-station company that is attempting to improve illuminating results in its community, it is necessary not only to look after the proper designs, but to have wiremen, foremen and the whole organization sufficiently educated to the importance of details that designs can be correctly carried out and that substitutions will be largely eliminated. In the meantime, it is a safe practice for every man who is engaged in trying to produce better illuminating results than the ordinary to watch every installation with which he is connected until it is finished.

## New Lamps and Renewal Rates.

One of the exasperating problems confronting the central-station manager to-day is the proper method of dealing with the new high-efficiency lamps where free renewals have been the practice. The 100-watt tungsten lamps are now coming into fairly common use, 60 and 40-watt lamps are in production and seen occasionally, and even 25-watt lamps of foreign manufacture are making their way into service. In the long run, as in the case of every other improvement, increased efficiency will mean more business and more profits, but during the formative period of high-efficiency lamp practice, the ordinary system of charging leads to some rather troublesome situations. The fundamental trouble is the present very high first cost of the lamps—in this country—$1.25 to $2.00, according to size, make and discounts. Of course, candle-power to candle-power the new lamps are cheaper sources of light than the old, including renewals, in the ratio of more than two to one at ordinary prices of current. The consumer actually wins out on any customary method of changing, but in a territory where free renewals have been the rule, he dislikes to assume the renewals even though he gains thereby, and especially if some of the lamps are, as is inevitable, of considerably shorter life than the average.

Tungsten lamps, worked even at 1.25 watts per candle, are upon the whole very long-lived. Tests abroad have indicated a life four or five times greater than that of the carbon-filament lamp, and at present 1000 hours is not an unreasonable expectation of life before dropping 20 per cent in candle-power, although manufacturers are slow in guarantees of so much. But it not infrequently happens that individual lamps break or blacken at a few hundred hours and demand costly renewals, to the consumer's sorrow, if he supplies his own lamps. What should be the policy of the central station in dealing with this matter? Can it afford to go in at the present time for actual free renewals, or should it guarantee renewals for a fixed charge, or a corresponding additional charge for current? On the face of the returns, the free renewal system is a considerable burden, equivalent not only to giving the consumer much cheaper light, but giving it to him at a cut rate for current. Yet, on examination, the difference in average renewals per candle-power is not so great as it seems. It takes about five 16-cp in-

candescents to give the light of one 100-watt tungsten lamp, and their life is on the average considerably shorter. When the tungsten lamps get down to the plane of cost which may fairly be expected, renewals per candle-hour will be as low or lower than with carbon lamps. But until the high-efficiency lamp has stimulated consumption so as to hold up the central-station income, free renewals will be a losing game.

This existing condition must be met in some way. Perhaps the most obvious scheme aside from throwing renewals upon the consumer, is that of assuming renewals at a fixed charge per lamp based on average life. In this way the station using many lamps can average up the losses from short life against the gains from long life, and come out square. Such is the policy often adopted by gas companies in putting out the so-called gas arcs, and it seems to work very well. This is one good reason for trying it in case of the new lamps. Or, again, one could put the same amount in the form of an extra charge per kw-hour, in which case the consumer would get only his ordinary meter bills. This extra rate method perhaps does not look as well on paper as the former. At first sight it appears like a discrimination against efficiency, as if a gas company should charge one rate for gas used in flat flame burners, and another for gas used in Welsbachs. It also complicates things if one works new and old incandescents on the same meter. In the last resort one must realize too that there is a considerable chance of still other high-efficiency incandescents appearing in the near future, having still other characteristics of life and economy, which will take still more time to evaluate. It therefore seems as though the safe course for the present would to be say frankly to the consumer: "Put on high-efficiency lamps if you want to—we are glad to furnish current for anything that comes along—but you will have to stand the expense until the costs of renewal become accurately determinable so that we can, in fairness to ourselves and to you, assume them." Of course, the exigencies of sharp competition may justify a company in taking some long chances, but, save for these, a waiting policy would seem to be the wise one until the situation, as regards the new lamps, is far more stable than at present.

## THE SWITCHBOARD RAMPANT.

The growth of the switchboard is one of the sensational features of electrical history. Originally the switchboard was regarded as a necessary evil, to be confined in expense and extent to the narrowest feasible limits. It was an adjunct to the generators existing for the purpose of connecting them to the lines, and having no other reason for being. At the present time all this has changed, and the board has pretty nearly become the end instead of the means. The tail is wagging the dog, and costs nearly as much to keep. The growth which has resulted in this state of things has been a perfectly natural one in a way, a gradual evolution from the simplest appliances, which has gone on, however, until the switchboard has become not only a very serious item of cost, rising to no inconsiderable fraction of the cost of the generators themselves, but a source of serious expense for repairs and maintenance, and one of the most vulnerable points of the system. The list of shutdowns from trouble here or in the leads thereto would be a very long one, indeed. Meanwhile, the appliances themselves have been greatly improved and refined so that the trouble seems to be mainly with the combination rather than with the component parts. The switchboard designer seems too often to ask himself how many permutations and combinations he can make with a given number of generators and feeders, rather than how the required service can be given in the simplest and safest manner.

It is, of course, true that high-voltage circuits have necessitated the use of far more elaborate and costly switches than were once needed. As another factor in the situation the size of recent power houses has compelled the adoption of remote control, in itself undesirable on the score of its complication. A remote-control oil switch, however, may in itself result in simplification of the system if it be judiciously used. But it is common enough to find remote control resorted to in cases where it is not in the least necessary and is apparently merely for the sake of a superficial uniformity of design. Such fetish-worship of uniformity is a common failing of the human mind. Nothing is more difficult, for instance, than to get an intricate piece of scientific apparatus built with strict regard to efficiency and economy, exquisite precision of fitting being introduced just where it is necessary and nowhere else. A recent scientific paper describes a struggle of this sort which ended in the maker leaving off only his nameplate. In a similar fashion apparatus is not infrequently furnished with innumerable attachments, many of which are seldom used, and are generally in the way. Now switchboard design has a similar failing, resulting in an attempt to provide in a perfectly systematic way for remote contingencies which, when they arise, are often best dealt with by abrupt departure from the system. In fact, the system is sometimes developed at the expense of safety.

The first function planned for a switchboard is the connection of the generators to the busbars; the second is the connection of the latter to the out-going lines. From this point on the functions are chiefly protective, to guard against various probable or remote contingencies, and one can go on almost indefinitely in adding devices to meet the requirements of intricate combinations of circumstances. There have been a good many debates among engineers as to the extent to which the various refinements should be carried, without very definite results. The main thing in planning them is a proper sense of proportion, a sound judgment of the relative importance of things, not in general, but in relation to the plant under consideration. Each system has peculiarities of its own resulting from the number and kinds of units, from the number and use of the lines, and upon the nature and amount of the auxiliary power available. It must not be forgotten that in switchboard operation the human element is a very important one, and that intricacy, in itself unobjectionable, may for this reason become a source of danger rather than of safety. One is at present rather tempted to preach the simple life in switchboard design. There is at present a good deal of construction which reminds one forcibly of the time-honored anecdote of Newton, who is veraciously reported to have cut a fair-sized hole in his study door for the convenience of the cat, and then another smaller one for the kittens. The important thing is that the construction shall, whether simple or more complex, be thoroughly and well done; that the appliances installed shall be of the best quality from an operative standpoint, and that they shall themselves decrease rather than increase the total chances of trouble. Automatic devices that require a man to watch them are rarely more effective than if they were non-automatic, and in the end are more costly.

## Iowa Electrical Association Convention.

The Iowa Electrical Association convention, held this year at Des Moines, Ia., April 22 and 23, was by far the largest in the eight years that this very successful central station organization has been holding conventions. The activity of the officers and the central location of the meeting place combined to make a large attendance. The Iowa Street & Interurban Railway Association held its convention during the same week, on April 23 and 24. The meetings and exhibits were at the Savery Hotel. The two associations prevented the usual extortionate charges of exhibitors by the hotel people by renting the old main dining room of the hotel and offering it to exhibitors free. This resulted in a much more instructive and complete exhibit than would have been brought out had exhibitors been obliged to pay big prices for hotel parlor exhibit space.

The first session of the convention was called to order on Wednesday by President George S. Carson, of Iowa City. In his address he referred to the tendency at present by commissions and arbitration boards to consider the value of an electric light property as the duplication value without regard to good will or the expense attached to bring the business to its present conditions. He said, however, that he felt that justice would be done to corporations by courts even if not by legislative bodies. In noting the advent of the tungsten lamp he said it would be able even to compete in cost with such cheap illuminants as gasoline and gas lamps.

Secretary W. N. Keiser, of Des Moines, presented as his report the printed proceedings of the last convention. Reports of executive committee meetings were read.

Mr. A. W. Zahm, chairman of the committee on co-operation, reported that the Co-operative Electrical Development Association expects to publish after the National Electric Light Convention a book for solicitors, which will be of great value. The material will be compiled from matter submitted for the solicitor's handbook prize competition.

The membership committee reported applications for membership from the central stations at Williams, Anamosa, Pella, Keokuk, Storm Lake, Ida Grove, Council Bluffs and Osage.

A nominating committee was elected by ballot, consisting of Messrs. L. D. Mathes, of Dubuque; Austin Burt, of Waterloo; John T. Moffitt, of Tipton; E. W. Hoag, of Manchester, and Thomas Crawford, of Clinton.

Mr. E. L. Callahan, of Chicago, presented a paper on popularizing the use of electricity, in which he dealt especially with the introduction of heating devices. This paper was discussed at length, especially with reference to the operation of "day circuits" in small towns.

It was announced that on Thursday evening, by the courtesy of the Des Moines Edison Light Company and the Des Moines City Railway Company, the convention would be entertained at the Majestic Theater.

On Wednesday afternoon the convention listened to an address by Mr. J. W. Ferguson, assistant contract agent of the Commonwealth Edison Company, of Chicago, on "Fact and System."

"The Economical Operation of a 200-kw Station" was taken up by Mr. Austin Burt, of Waterloo, who gave some figures on results attained in securing a day load which proved very interesting.

"Grounded Secondaries" was discussed in a paper by Mr. Thomas Sloss, of Cedar Rapids, in which the advantages of grounding were well brought out. The discussion dwelt principally on the best method of securing a ground, and finally a committee was appointed to investigate and report upon the best method of grounding. Mr. Sloss, Prof. T. A. Fish, of Ames, and J. A. Inness, of Eagle Grove, were appointed as this committee.

"Incandescent Lamp Development," a paper by Mr. F. W. Willcox, was read by Mr. George C. Osborne, of the General Electric Company. This paper treated the tungsten lamp situation very thoroughly, and brought out an extended discussion, taken part in by Mr. Geo. Loring, of the National Electric Lamp Association; Mr. L. D. Mathes, of Dubuque, President Carson and others.

On Thursday morning short talks on meeting gas and gasolene competition were given by Messrs. Gus Lundgren, of Cherokee, and M. A. Harrison, of Nevada. After a profitable discussion of these subjects, Prof. A. H. Ford, of Iowa City, read a paper on "Electric Motor Characteristics."

The question of freight rates was taken up in two papers, one being the report of Mr. Thomas Crawford, of Clinton, chairman of a committee appointed on that subject at the last convention, and the other a paper by Mr. E. G. Wylie, of Des Moines, on the freight rate situation as regards Des Moines and the recent controversy over it.

On Thursday afternoon, new business methods were dealt with in a number of short talks, participated in by Messrs. J. F. Porter, of Davenport; A. L. Dodd, of Charles City, and C. E. Walters, of Toledo; Thomas Ferris, of Osage; Austin Burt, of Waterloo, and O. E. Brownell, of Lake City.

The convention went into executive session to discuss various matters, and fixed upon the third Wednesday in April as the regular date for the convention hereafter. The next convention is to be held at Cedar Rapids.

Officers elected for the coming year are as follows: President, L. D. Mathes, of Dubuque; vice-president, O. E. Brownell, of Lake City; treasurer, W. A. Mall, of Belle Plaine; secretary, W. N. Keiser, of Des Moines; executive committee, Thomas Sloss, of Cedar Rapids; F. L. White, of Traer, and J. F. Porter, of Davenport.

The timely papers and discussions at this convention were of the practical character which has given the Iowa Electrical Association its high place among state associations of this kind.

## Committees of the Underwriters' National Electric Association.

At the annual meeting of the Underwriters' National Electric Association various suggestions and proposed rules are given into the hands of special committees appointed by the chairman, who report their recommendations and findings either to the electrical committee or to the association at its annual meeting. Chairman Cabot has appointed the various committees called for at the annual meeting, which are given below, together with the respective chairmen:

Committee on signs and outline wiring, Mr. J. C. Forsyth, 32 Nassau Street, New York; committee on Rule 64, signaling systems, Mr. F. E. Cabot, 55 Kilby Street, Boston; committee on transformers, Mr. C. H. Hill, 316 Walnut Street, Philadelphia; committee on telephone switchboard lighting, Mr. R. P. Strong, 809 Hibernia Building, New Orleans; committee on electric cranes, Mr. G. S. Lawler, 31 Milk Street, Boston; committee on Rule 2*a*, Mr. G. E. Bruen, 135 William Street, New York; committee on switches and cut-outs, Mr. H. O. Lacount, 31 Milk Street, Boston; committee on variable-speed motors, Mr. H. O. Lacount, 31 Milk Street, Boston; committee on approval of laboratory reports, Mr. George E. Bruen, 135 William Street, New York; committee on fixture wire, Mr. Dana Pierce, 382 Ohio Street, Chicago; committee on auto starters, Mr. C. H. Hill, 316 Walnut Street, Philadelphia; committee on re-codification of the Code, Mr. C. M. Coddard, 55 Kilby Street, Boston; committee on details of switchboard, Mr. Ralph Sweetland, 55 Kilby Street, Boston; committee on cut-out cabinets, Mr. A. R. Small, 382 Ohio Street, Chicago; committee on Rule 13*a*, Mr. C. M. Coddard, 55 Kilby Street, Boston; committee on specifications for stage and elevator cables, Mr. J. E. Cole, 11 Wareham Street, Boston; committee on rheostats, Mr. George E. Bruen, 135 William Street, New York; committee on induction motors as to wires and fusing, Mr. F. E. Cabot, 55 Kilby Street, Boston; committee on circuit-breakers, Mr. S. N. Schoen, 339 Equitable Building, Atlanta; committee on mercury-vapor lamps, Mr. J. C. Forsyth, 32 Nassau Street, New York; com-

mittee on street railway property, Mr. Ralph Sweetland, 55 Kilby Street, Boston; committee on theater wiring, Mr. J. E. Cole, 11 Wareham Street, Boston.

## Missouri Electric Light Convention.

The Missouri Electric Light, Gas & Street Railway Association, which was organized in 1907, held its annual convention at the Marquette Hotel, St. Louis, Mo., April 23, 24 and 25, 1908.

The meetings were presided over by Dr. J. D. Porterfield, of Cape Girardeau. Mr. C. L. Clary, of Sikeston, Mo., acted as secretary in place of Secretary C. Z. Pierson, who removed from the State during the year.

The first session was opened on Thursday morning by an address of welcome by Mr. W. A. Layman, of St. Louis, responded to by President Porterfield. The reading of the report of the secretary and the holding of an executive session occupied the balance of the morning.

At 2 p. m. Mr. Hugo Wurdack, of St. Louis, gave an address on economical secondary distribution and Mr. R. L. Lanphier an address on watt-hour meters. At 8:30 p. m. a smoker was given at the Marquette Hotel.

On Friday morning Mr. E. W. Houghton, of Chicago, reviewed the incandescent lamp situation with especial attention to the present status of the tungsten lamp. Mr. Geo. C. Osborne and Mr. Geo. Loring then talked on the same subject and a general discussion by central station men followed. On Friday afternoon Mr. Horace W. Beck, of St. Louis, addressed the convention on "Central Station System and Records." "Popularizing the Use of Electricity" was the subject of a paper by Mr. E. L. Callahan, of Chicago. The Sons of Jove held a rejuvenation and smoker in the evening.

Saturday morning an executive session was held, after which a paper on "Alternating Current Motors," written by Mr. W. Robbins, of St. Louis, was read by Mr. A. H. Timmerman for the author. This paper showed the proper types of alternating-current motor for various kinds of service.

The meeting was then thrown open for the answering of various questions asked by members, which resulted in a profitable discussion of various topics.

The officers elected for the ensuing year are: W. B. Hays, of Poplar Bluff, president; Ralph Irvine, of Marshall, first vice-president; F. E. Murray, of Louisiana, second vice-president; P. A. Bertrand, of Jefferson City, third vice-president; C. L. Clary, of Sikeston, secretary and treasurer. Executive committee: W. A. Bixby, Springfield; H. D. Hibbeler, of Washington. Finance committee: P. A. Bertrand, of Jefferson City; Thomas Fox, of Cape Girardeau, and Ralph Irvine, of Marshall. Advisory committee: O. M. Munroe, of De Soto; W. A. Bixby, of Springfield, and B. S. Bertrand, of Jefferson City.

A rule was adopted to make the date of the convention the first Thursday after April 10, each year. On Saturday evening the electrical supply men of St. Louis gave a banquet to the members.

The convention was one in which the interest never lagged and the 20 central stations which sent representatives were well repaid.

## Exhibition of Safety Devices.

Much interest has been manifested in the exhibition of safety devices which is being made under the auspices of the American Institute of Social Science at 231 West Thirty-ninth Street, New York, and which will continue for over another month. The exhibition, which is open to the public, contains a number of electrical devices. A working model of an automatic gate for railroad crossings is shown by the Automatic Gate & Signal Company. The gates close on the approach of a train and open after the train has passed, at the same time ringing an alarm. The electricity for operating the gates is furnished from a storage battery or by direct supply. The actuating relay is thrown by the current taken from an insulated section located about two miles from the crossing.

A model of the Nachod automatic signal for electric railways is shown by the United States Engineering Company. This signal system is designed to prevent head-on collisions on single-track lines, and indicates automatically the presence and direction of the car on the block by a system of lamps and semaphores at turn-outs.

The Rich marine fire indicating system also forms an interesting feature of the exhibit. In this system pipes connected to the various parts of a ship terminate in a case in which is an electric exhaust fan set in motion by clock contacts every 15 minutes. Should a fire occur smoke will be sucked up through the pipe into the chamber by the fan, whereupon a steam connection is made and steam under pressure is forced down the pipe into the compartment where the fire is. Another electrical means for indicating fire and giving an alarm is shown in the exhibit of the Montauk Fire Detecting Wire Company. Thermostatic wires close a circuit which sounds an alarm as soon as the temperature has reached a certain value.

## Poulsen on Wireless Telephony.

Prof. Valdemar Poulsen, the Danish inventor, read a paper before the Royal Institution in London two weeks ago on his system of wireless telephony. After detailing how he had succeeded in carrying the human voice through the air a distance of about 200 miles, that is to say, between Copenhagen and Berlin, Mr. Poulsen is reported to have spoken as follows:

"The essence of my discovery is its simplicity, and it resulted from another discovery I made several years ago that the rapid passage of electricity to and fro produces an effect known as the 'singing air.' This singing I found produced notes too low for the air to hear and some that were too high to be understood, so in order to make the notes understandable I arranged an apparatus consisting of coils of wire, joined in series to a condenser with leads to the source of the current, joined by two carbons in parallel.

"I found that the current flowed rapidly in the arc between the carbons, oscillating to and fro, and the oscillation was enormously improved by occupying the intervals between the carbons with hydrogen gas. This resulted in continuous undamped waves which can easily be tuned to any desired plan, so that they will only influence those instruments which are arranged to correspond with the sending instrument."

Coming to the pure telephone and efforts to establish wireless communication, Mr. Poulsen said that the waves that Bell had harnessed by the use of mirrors had proved to be without value, but with the undamped waves, each exactly like its predecessors, the problem had been solved. These regular waves transmitted sound perfectly, and by means of them it had been possible to telephone a tune, without wires, 290 miles, and to make a human voice recognizable at a receiving station 170 miles away from the person speaking. At the close of the paper some interesting demonstrations of the new method of communication were given.

## Equipment for Nevada-California Power Company.

The Nevada-California Power Company is installing an additional generating station on Bishop Creek. This will be the third plant located on this stream, all three to use the same water and to operate in parallel to transmit energy 120 miles to the southern Nevada gold fields.

The new installation will consist of three 2000-kw, 2200-volt, three-phase, 60-cycle generators connected to over-hung tangential waterwheels operating at 300 r.p.m. The wheels will receive water through a 48-in. steel pressure pipe 2800 ft. long. The pressure pipe is joined to a 48-in. wooden-stave pipe line 10,000 ft. in length. Six 1000-kw transformers will be used to raise the generated e.m.f. to 55,000 volts for the transmission system.

## International Acheson Graphite Company Improvements.

Additions to cost about $100,000 are about to be made to the plant of the International Acheson Graphite Company in Niagara Falls. Ground has been broken and work is under way on a new switchboard building. This building will be of brick, 36 ft. long by 20 ft. wide. It will house all the receiving and distributing panels, the present switchboard to be transferred to it when it is ready. The electrical apparatus, transformers, regulators, busbar system, etc., will cost about $20,000. The energy is supplied by the Niagara Falls Power Company at an e.m.f. of 2200 volts.

Other very important features of the improvements in progress will be a new furnace room, and a new grinding and storage building. The new furnace room building will be a one-story structure 120 ft. long by 100 ft. wide. The frame will be of steel, the walls of brick. It will provide room for 12 additional furnaces, which will make it possible to double the output of the plant.

The new grinding and storage building will be of steel and brick, 100 ft. long, 50 ft. wide and three stories high. When the improvement is completed the present grinding room will be merged in this new building. A portion of the new structure will be devoted to the storage of graphite and stock goods in general, particularly electrodes. It was in 1897 that the manufacture of graphite on a commercial scale began in Niagara Falls, and since then there has been a splendid increase in the business. It is stated that despite the industrial depression that prevailed, the Acheson company booked more orders during the first quarter of 1908 than during the corresponding period in 1907. This appears to be particularly true of "Oildag."

## Japanese Electrical Science Association.

At present there are three organizations in Japan which are directly connected with the electrical science. These are the Telegraphic Science Association, Electrical Association and Electrical Science Association. The last named is the largest and strongest and occupies the position in Japan that the American Institute of Electrical Engineers does in this country. The objects of the association are also similar to those of the institute.

The members of the society are divided into four classes—full members, associate members, honorary members, and "sustaining" members. An engineer who has graduated from a college, or has been in a responsible position for three years and is familiar with the electrical science, or has extensive practical experience and knowledge in electrical engineering, or who is closely connected with the electrical science and is likely to contribute something to the science, may be admitted as a full member.

One who has studied and is connected with electrical science, but not qualified to be a full member, may be an associate member. Persons very prominent in the electrical field may be elected to honorary membership. A sustaining member is one who has contributed $25 or more to the association. The board of directors, which consists of twelve members, has the power to accept or reject applications for membership.

The officers are a president, two secretaries, twelve directors, two recording secretaries, two treasurers and an editing committee, consisting of six members. The present president is Baron Otori.

A meeting is held at Tokio every month, except July and August. Papers are presented at these meetings, and at times the discussions on papers are lively and interesting. The papers and discussions thereon are published and distributed to the members.

In the January issue Mr. S. Kanda, an authority on the telegraph, has an original paper entitled "The Sag of a Wire Suspended at Two Points of Support at Different Levels." Annual meeting is held, which is largely of a social nature, the greater portion of time being devoted to excursions, dinner parties and social diversions.

The association has been in existence for twenty years, and almost all Japanese electrical engineers are members. According to the report of last December, the number of the full members is 641; associate members, 610; honorary members, 6; "sustaining" members, 20.

## Convention of the Southwestern Electrical & Gas Association.

The annual convention of the Southwestern Electrical & Gas Association will be held at El Paso, Tex., on May 5 and will continue in session for three days. The headquarters of the association will be at the St. Regis Hotel and the business sessions will be held in one of the rooms of that hostelry. The exhibits of the manufacturers and supply houses will be given space in one of the sample rooms of the hotel.

The following program of papers has been prepared: "Track Construction," Mr. Mark Lowd, of Dallas; "Gas Engines and Producers," Mr. W. B. Tuttle, of San Antonio; "Wood Preservation," Prof. E. P. Schoch, of Austin; "Testing and Proving Gas Meters," Mr. J. A. Myler, Jr., of Dallas; "Various Forms of Electric Illumination and Their Efficiency," Mr. C. W. Kellogg, Jr., of El Paso. There will be a general discussion of the question, "What Policy Should be Pursued by Public Service Corporations in Making Extensions?" Mr. E. T. Moore, of Dallas, and Mr. J. A. Porter, of Paris, Tex., will present the question for the electric-light companies; Mr. H. M. Moore, of Austin, and Mr. C. H. Dunbar, of Houston, for the gas companies; Mr. H. S. Cooper, of Galveston, and Mr. F. E. Scovill, of Laredo, for the street-railway companies, and Mr. J. E. Farnsworth, of Dallas, for the telephone companies. Other papers in addition to those embraced in the program above will be read.

The entertainment program consists of a tally-ho ride through El Paso and Juarez, Mexico; a visit to the big smelter; a trolley ride over the city, followed by reception and luncheon; a visit to Fort Bliss, followed by reception and band concert. On Friday, May 8, there will be a grand rejuvenation of the Sons of Jove.

## Daylight and Artificial Light.

At the May meeting of the New York section of the Illuminating Engineering Society, to be held on Thursday, May 14, at 8:15 p. m. at the Engineering Societies Building, Dr. E. L. Nichols, of Cornell University, will present an illustrated paper on "Daylight and Artificial Light." Dr. Nichols recently traveled extensively throughout Europe and northern Africa, making spectro-photometric determinations of the quality of daylight under widely varying conditions, involving about 150 sets of observations. Deducing from these an average value for daylight, he will compare various artificial illuminants to such value through spectro-photometric measurements. The meeting will be open to all who wish to attend.

## May Meeting of the A. S. M. E.

The next meeting of the American Society of Mechanical Engineers will be held Tuesday evening, May 12, in the Engineering Societies Building, New York. The paper will be by Mr. Henry Souther, of the Henry Souther Engineering Corporation, Hartford, Conn., on the subject of "Clutches," with special reference to the types used on automobiles. Their development will be shown by lantern slides. The meeting will be important not only to those directly interested in automobile construction, but to all who have to do with the use of clutches for machine tool work, power transmission, hoisting machinery, textile and other classes of machinery. The meeting will afford an opportunity for the full discussion of their design and use. The discussion will be continued at the semi-annual meeting of the society at Detroit, Mich., June 23 to 26.

## Tests of Fuels for Producer-Gas Plants.

The accompanying table shows the results obtained on a wide range of fuels tested by the technologic branch of the United States Geological Survey, under the direction of Mr. Joseph A. Holmes, expert in charge, and Mr. Robert Heywood Fernald, engineer in charge. These tests were made at St. Louis, Mo., at the fuel-testing plant which was located on the grounds of the Louisiana Purchase Exposition. At the time this plant was erected there were but few gas-producer plants in the country burning any class of bituminous coals, and many prominent engineers were in doubt as to the possibility of operating a gas engine on gas produced from coals such as are mined in the Central and Western States.

This branch has done a valuable service to the country in demonstrating the possibility of burning nearly all classes of low-grade fuels with good economy. As will be noted in the table the poorer coals required a correspondingly greater quantity of the fuel to produce a horse-power.

DATA AND RESULTS ON REPRESENTATIVE FUELS BURNED IN A PRODUCER GAS PLANT.

| Fuel. | Proximate analysis, per cent. Moisture. | Volatile matter. | Fixed carbon. | Ash. | B.t.u. per pound of fuel. As fired. | Dry. | Cu. ft. standard gas produced per pound of equivalent* fuel consumed by producer plant. As fired. | Dry. | B.t.u. per cu. ft. of standard gas. | Pounds of equivalent* fuel per B.H.P. Hr. As fired. | Dry. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Florida peat ..... | 21.00 | 51.72 | 22.11 | 5.17 | 8,127 | 10,289 | 28.5 | 36.1 | 175.2 | 2.57 | 2.03 |
| Average of four lignites..... | 35.05 | 28.96 | 27.72 | 8.27 | 7,164 | 11,038 | 26.3 | 40.3 | 169.9 | 2.43 | 1.73 |
| Avg. of four Penna. coals.. | 11.51 | 31.81 | 43.46 | 15.22 | 10,651 | 12,030 | 49.6 | 56.1 | 153.2 | 1.66 | 1.47 |
| Avg. of four Penna. coals... | 3.47 | 19.68 | 67.31 | 9.54 | 13,651 | 14,136 | 71.4 | 74.0 | 141.6 | 1.16 | 1.12 |
| Avg. of four W. Va. coals.. | 2.47 | 32.12 | 60.24 | 5.17 | 14,248 | 14,610 | 77.5 | 79.5 | 149.6 | 1.03 | 1.00 |

*Equivalent fuel includes that used in the producer, and also the amount required to generate the steam necessary for operating the producer.

Of the four Pennsylvania coals tested, two came from the lower Kittanning bed, one from the Lower Freeport and the fourth from the Pittsburg bed. Of the West Virginia coals, one came from the Ansted bed, another from the Eagle, both of these being in the New River district; a third from the Pittsburg and the fourth from the Keystone bed.

The equipment used was a 250-hp pressure producer with a centrifugal tar extractor and gas holder. A 235-hp, three-cylinder, vertical gas engine belted to a generator-produced power which was measured by electric instruments connected with the switchboard. As will be seen, the results are much better than those from steam plants of corresponding size.

## German Wireless Rates.

Consul Wilbur T. Gracey, of Tsingtau, transmits the following information regarding wireless telegraph installations which have recently been placed on the ships of the Hamburg-America Line running between Shanghai, Tsingtau and Tientsin:

"Sea telegrams are those which are exchanged between ships at sea and the stations situated on land. They must, when forwarded by way of wireless stations, be either in plain words or in code terms contained in commercial cable codes. If intended for ships at sea, the address must contain, in addition to its usual contents, the name or official number of the ship and its nationality.

"The rates from Tsingtau to ships at sea or vice versa are 5 cents Mexican (approximately 2½ cents gold) per word, with a minimum charge of 10 words. For messages from ships at sea to other places or countries the rates of the German post-office as published are applicable. In addition to this word rate, a fixed sumptuary sea rate of 40 cents per message will be added. Total charges on messages sent to ships are payable by the sender, on messages received from ships by recipient.

"Telegrams sent to ships at sea are, like all other telegrams, sent through the German post and telegraph office, and messages from ships at sea are delivered to recipients in the same way. A wireless station is situated at Tsingtau, and instruments have been installed on the *Admiral von Tirpitz* and the *Staatssekretar Kraeike*, of the Hamburg-America Line."

## Side Lights on the Fuel Problem.

At the annual meeting of the National Association of Cotton Manufacturers, held in Boston, Mass., April 16-17, Mr. E. G. Bailey read a paper entitled "Some Things a Manufacturer Should Know About Coal," in which the following points bearing upon boiler room operation were brought out: There are yet many things to be learned about coal, and one of the most baffling phenomena so far investigated is the spontaneous combustion of coal under storage. When a plant is located at any great distance from the mines, coal storage is a necessity, and this inevitably involves additional expense due to the extra handling, value of storage space, and loss of coal, both mechanically and chemically. There are many theories as to the cause of spontaneous combustion, the presence of sulphur being generally charged with this trouble, but many cases of combustion occur in piles of coal that contain less than one per cent of sulphur, and analyses of coal from heated piles show that only a small percentage of sulphur has been oxidized. It appears that the rate of circulation of air through the coal has more to do with this question than the presence of sulphur, pyrites, excessive moisture, variations in the height of the pile, or any other condition outside the character of the coal. The heating of a pile is usually so irregular that the ordinary temperature measurements made by letting down a thermometer in pipes scattered through a pile are liable to miss entirely the hottest spot. Storing coal under water seems to be the only method of absolute prevention known at present.

It is not always the better or higher-priced coals that give the most satisfaction in plants that are very limited in boiler capacity, that have such poor draft or some kind of stoker that it is possible for the boiler room force to keep steam only with certain kinds of fuel. The percentage of volatile matter, amount of ash, and coking properties are very important factors in the rate of combustion. In buying steam coal the amount of heat that may be developed is the measure of its value, but two coals at the same price and containing the same number of heat units may not be equally desirable. It is a very common practice to buy coal in these days on the strength of heat units, but there are other factors to be considered. The difference in volatile matter may cause one coal of the same calorific power to be preferable to another on account of smoke restriction, while a higher volatile coal would probably be more useful in a plant with fluctuating loads. The liability of a coal to spontaneous combustion may make it advisable to pay several cents a ton more for one coal containing no more heat units than the other. For steam purposes sulphur is of little importance below two per cent at least, so that a coal containing less ash might in a given case be selected on its cost of five or ten cents a ton less on the heat unit basis, even though its sulphur were nearly double that of its competitor.

In case a plant has a limited draft and boiler capacity a coal with 30.5 per cent volatile matter might be selected in place of one containing 22 per cent more fixed carbon, 13 per cent less volatile matter, and 100 more heat units per pound, even though the former cost 8 cents per ton more than the latter, or $2,500 on a year's order of 50,000 tons. A difference of 28 cents per ton f. o. b. the plant, or 4 cents per ton on the basis of heat units would scarcely pay the extra cost of handling

ashes with a coal of 730 more heat units per ton and 4 per cent less ash, especially if there is a danger of not being able to carry the load without the use of more boilers and other expenses that are greater with a poorer coal. A coal that when compared with half a dozen others is the best all-around fuel might not be the best to buy if one of the competitors could be obtained for 20 cents per ton cheaper on the heat unit basis, and 19 cents per ton cheaper on the evaporation basis. Again, a coal might appear to be superior on account of less ash and sulphur in its analysis, but if it had a high percentage of moisture, say, 3.7 compared with from 1.25 to 1.4 in its competitors, the purchaser might be paying as much as 20 cents per ton less for the former, and yet he would have to burn so much more of it to develop the same horse-power that he would actually be losing 32 cents per ton, or $16,000 per year on a 50,000-ton contract.

The analysis of flue gases is the best criterion for regulating the conditions of a furnace so as to obtain nearly complete combustion with a minimum of air excess. The perfecting of automatic gas indicators and flue gas recorders will do much toward increasing the boiler room efficiency. In operation, the important point is to cool the gases as much as possible with a minimum of boiler heating surface. Too much emphasis cannot be laid upon keeping the heating surface clean inside and out. There is an opportunity in many plants to save thousands of dollars per year by merely reducing the draft or regulating it more carefully. The choice of stokers, design of furnaces, determination of ratios between heating and grate surface, testing of fuel saving devices and smoke preventers, and the determination of the best way to fire different kinds of coal under different boilers is still open to the widest investigation. The plea for evaporative tests because they are practical is counterbalanced by their frequent failure to burn coal under equally comparable conditions in two or more cases. Chemical analysis and calorimetric determination will represent the value of coal within 1 per cent, if the samples are properly taken, and the fact that a coal company knows its coal is being systematically analyzed is generally sufficient to insure the delivery of a coal of uniform quality.

## Death of the Oldest Telephone Manufacturer.

The present generation of electrical engineers is not particularly familiar with Mr. Charles Williams, Jr., who died on April 15 at Somerville, Mass.; but it is a fact that he was in his day one of the foremost electrical manufacturers in this country, and one whose work on early telephonic apparatus, in association with Prof. A. G. Bell, gives him a place in the history of the electrical arts. Mr. Williams began his career in the electrical field in Boston in the early forties, and was a member of the firm of Hinds & Williams, dealers in and makers of electrical apparatus and supplies. After a time Mr. Hinds retired, leaving the business in the hands of Mr. Williams. It was in his workshop on Court Street, Boston, that much of the early work on the telephone was done by Prof. Alexander Graham Bell, and by Mr. T. A. Watson, who was appointed by Mr. Williams to take charge of this work for Bell. The testimony and briefs in all the earlier telephonic litigations, as well as the histories dealing with the subject, are full of data with regard to this early experimental work. The following typical passage may be quoted from Mr. Watson's evidence:

"We had a line running from the attic to Mr. Williams' factory to the third story. In the attic we connected a harmonic receiver. I shouted into the membrane telephone. Mr. Bell listened at the receiver. I think he heard nothing. We changed places. He shouted at the telephone and I listened at the receiver. I could hear a faint sound.

"On Saturday, July 5, I tried the membrane telephones. . . . I carried on conversation with Professor Bell successfully. On Monday, July 7, I placed the instruments in circuit between the attic and third story of Mr. Williams' factory under almost precisely the same conditions as the experiment of July 2, 1875. I could occasionally hear very faint sounds."

In April, 1877, the first telephone line, properly speaking, was stretched from the Court Street factory to the residence of Mr. Williams in Somerville, and before the end of the month other lines were put into operation. From this time on the art of telephony and the business of telephonic manufacturing developed with leaps and bounds. Mr. Williams himself contributed no small amount of energy and skill to the perfection of the apparatus. His factory supplied for a long time all the material needed by the National Bell Telephone Company, and he was for several years the sole licensed manufacturer of the company. The Williams magneto call bell and the Williams switchboard were leading elements in the early art, and are remembered to this day as standards of excellence and utility.

It is a curious fact that Mr. Williams was paid for much of his earlier work in Bell telephone stock, which he took with considerable reluctance, but it was practically the only available asset of the struggling parent company. Soon afterward that which had been looked upon with hesitation and doubt became extremely valuable, and the exchange of the old stock for new, as well as the dividends earned and the profits of his manufacturing business soon made Mr. Williams a wealthy man.

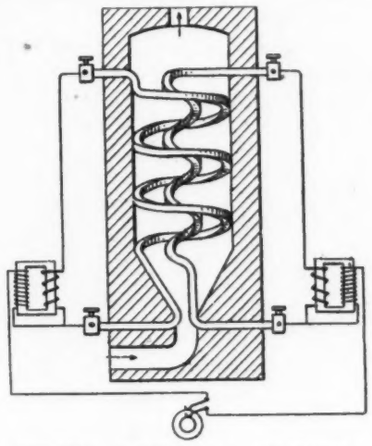
In 1886 he retired from the field as licensed manufacturer for the American Bell Telephone Company, and the famous Western Electric Company came into existence, with its huge factories in New York and Chicago, as well as in Europe. Mr. Williams again benefited by the transaction and became a very large stockholder in the Western Electric Company, of which, until the time of his death, he remained a director. He also took an active share in the development of other Bell telephone interests and was for a time president of the Tropical American Telephone Company. His later years had, however, been passed in more or less retirement, until his death, which was due to bronchial pneumonia. Mr. Williams was one of the earliest members of the American Institute of Electrical Engineers, joining in 1884—the date of his membership being that of his death, April 15. He did not, however, take any conspicuous part in electrical affairs outside of his business interests, and to-day, to the great majority of electricians, had become little more than a name; although his share in the creation of a great art can never be overlooked or forgotten.

## Phenomena of Mercury-Vapor Lamps.

A United States patent issued to Richard Kuch, of Hanau, Germany, on April 7, the application for which was filed on Dec. 7, 1905, describes some interesting phenomena of mercury-vapor lamps. The inventor states that on increasing the e.m.f. impressed on the lamp far beyond the point hitherto tested an unexpected change takes place. The curve of efficiency of the lamp then changes its direction and the efficiency will quickly rise, so that its value will be far more favorable than the most favorable values hitherto attained for a low electric potential. The consumption reduces to 0.17 watt per candle-power and no limit appears to have been as yet reached in this reduction. The electric potential of the lamp was in this case increased up to about 25 or 30 volts per centimeter of the length of the column of light; in other words it was from 25 to 30 times that potential which has hitherto been employed for attaining the most favorable efficiency. This entirely unexpected behavior of the gas or vapor electric lamps with mercury electrodes the inventor explains by the following theory: For a certain potential of the lamp the light furnished by the radiation of the luminescence of the dissociated mercury vapor is supplied by a further radiation, presumably that of the temperature in consequence of the temperature increasing with the specific weight of the vapor. The radiation of the temperature produces a rapidly increasing efficiency, which compensates for the decrease of the efficiency of the radiation of the luminescence and moreover it produces a very considerable improvement in the total efficiency. The inventor states that a lamp for 110 volts need be only 6 cm in length as compared with the usual 50 cm.

## Electric Gas Apparatus.

The accompanying illustration shows an apparatus for treating gases by means of electric arcs, for which a patent was issued to Mr. A. J. Peterson on Feb. 25. The apparatus is so arranged that the gas is acted upon by a large number of arcs, each arc being forced upward by electrodynamic action. In order to render the latter action as effective as possible the current which reaches the arc is passed through series transformers so that the secondary currents bear a certain large ratio to the arc current; the secondary circuits, which are used as the electrodes, are spirally wound with the same pitch, but with different diameters. During operation the arcs run along the spirals and act upon the gas at many points. It is claimed that the compounds obtained by reason of the ironizing action of the arcs are thus prevented from being again dissociated.



PETERSON ELECTRIC GAS APPARATUS.

## Commercial Day at the N. E. L. A. Convention.

One of the subjects on the program for Commercial Day (May 21) at the convention of the National Electric Light Association in Chicago, will be "Advertising," which will be handled by Mr. Chas. A. Parker, formerly editor of the *Booster*, which was started by the Co-operative Electrical Development Association. An illustrated lecture will be delivered by Mr. V. R. Lansingh, dealing particularly with store illumination.

## Cleveland's Three-Cent Fare.

The seven-year contest that has been waged in Cleveland, Ohio, for lower street railway fare and public control of urban transportation seems at last to have ended. The Municipal Traction Company, which has leased the various railways for 50 years, expects to inaugurate the three-cent fare during the first week in May. This company obtained possession of the property of the Cleveland Railway Company, a new corporation, which took over the consolidated properties of the old companies.

## Bottled Gas.

Prof. Hallock lectured before the Chemists' Club, in New York City, April 24, on "Blaugas." This is liquid illuminating gas discovered by Professor Blau, of Germany, and while it is not manufactured in this country, it has found an extensive use in Germany, where it is sold by weight. A 22-lb. cylinder contains enough liquid gas to supply a 50-cp burner for four months if used four hours a day. Very small copper tubes, about the size of an electric light wire and just as flexible, connect the burners with the reservoir.

## CURRENT NEWS AND NOTES.

*CONTROL OF WIRELESS COMMUNICATION.*—The President has sent to the Senate the reports of the War and Navy Departments and the Department of Commerce and Labor on the international wireless telegraph convention signed at Berlin Nov. 3, 1906. All three departments recognize the necessity for some rules governing the exchange of aerial messages and applaud the convention. The need is urgent, for the reason that there are now in the United States 97 wireless shore stations. Of these 40 are operated by the navy, 16 by the army and 41 by private concerns. A bill is now under consideration by Congress providing for rigid governmental control of wireless communication, and fixing penalties for private persons who interfere with government messages or indulge in "fake" messages. This bill was referred to in these columns at the time of its introduction.

*PURE WATER FOR NIAGARA FALLS CITY.*—Governor Hughes, of New York, has signed the bill that provides for the appointment of a board of water commissioners for the city of Niagara Falls. The duty of this commission will be to determine upon a plan for providing the entire city with a supply of pure water for fire, domestic and industrial purposes. The commission will have seven members, including the mayor in office. It is suggested that a tunnel be driven out under the river to the Canadian channel, where it is alleged that the water is of better quality than along the American side. As yet filtration is not suggested, but those who look ahead realize the necessity. The plans, after being perfected, must be ratified by the taxpayers at a special election. All the electrical companies and industries are in favor of a better water supply. At present there are two plants, one being operated by the Western New York Water Company, the pumps of which installation are in the wheel-pit under power house No. 2 of the Niagara Falls Power Company, and a municipal plant operated by water from the hydraulic canal basin. The entire project will cost the citizens of Niagara Falls several million dollars.

*A GLANCE AT CONDITIONS.*—It is interesting to note that the representatives and correspondents of Spencer Trask & Company returned recently from their trip of inspection of the properties of the Milwaukee Electric Railway & Light Company, the Milwaukee Light, Heat & Traction Company, the Detroit Edison Company and the Cleveland Electric Illuminating Company very much pleased with the outlook. One prominent member of the party said: "In each case the party was greatly impressed with the excellent condition of the plants, and the broad and comprehensive plans on which the construction has been carried out. The improvements in modern machinery are so rapid that it is necessary to maintain the operating efficiency of public utility properties at the highest standard in order to obtain the best results. A large part of the machinery inspected has been in operation for only two or three years. With every degree of conservatism, the various companies are planning additions and improvements to provide for the increased requirements which are already evidenced, and which may reasonably be expected to be upon a constantly increasing scale. In the investment field there seems to be an abundance of funds awaiting investment in the best class of securities of sound properties, but owing to the recent panic, individual investors are evidently, and quite naturally, more determined than ever to place their funds only in securities combining safety of principal and interest, and promising reasonably large appreciation in value. It is not unlikely, therefore, that this feeling will have its effect on local legislation pending, the country over, making it apparent that in order to raise the necessary cash to provide ample facilities for the convenience and comfort of the public the laws governing utility corporations must not be burdensome, but reasonably fair to both the corporations and the public."

*WIRELESS MOTOR CAR.*—According to a newspaper dispatch an Omaha inventor has devised an apparatus whereby a motor car can be started and stopped from a distance by wireless telegraphy.

*NATIONAL ARCHITECTURAL EXPOSITION.*—A National Architectural Exposition will be held during the week of Sept. 14-19 at Madison Square Garden. The scope of the exposition will include building engineering, construction and equipment, interior and exterior decorations and furnishings.

*FUEL TESTING.*—Bulletin No. 332 of the U. S. Geological Survey consists of a report by Mr. Joseph A. Holmes of the U. S. fuel-testing plant at St. Louis. Descriptions in detail are given of the various tests applied to fuel, and tables give the results of tests upon coal from mines in various parts of the country.

*INCREASE IN ELECTRIC RAILWAY FARE IN MASSACHUSETTS.*—The Massachusetts Railroad Commission in the matter of a protest entered by the patrons of the Blue Hill Street Railway Company against an increase in fare to 6 cents, has decided that this increase was justifiable and dismissed the petition.

*LAMP PATENTS.*—An additional development in the condition of the Patent Office contention between the government and Mr. John A. Heany, noted in our first issue for March, was recorded on April 13, when a bill was filed to annul the Heany tungsten lamp patent, it being alleged that the patent was fraudulently obtained.

*ELECTRIC METER INSPECTION IN THE DISTRICT OF COLUMBIA.*—A bill has been introduced into Congress to establish a system of electric-light meter inspection in the District of Columbia, one of the provisions of which is that all meters are to be considered correct which do not depart more than 3 per cent from accuracy.

*FIRES DUE TO LIGHTNING.*—The Continental Fire Insurance Company has published statistics giving the number of fires and their causes in connection with claims paid by the company for the period 1899 to 1907 inclusive. The total number of fires ascribed to lightning during this period is 5771, or 7.22 per cent of the grand total.

*LEHIGH GRADUATES.*—The probable number of graduates in June from Lehigh University is 128, distributed as follows: Electrical engineers, 18; electrometallurgist, 1; mechanical engineers, 28; civil engineers, 40; chemical engineers, 3; master of science, 6; bachelor of science in chemistry, 3; engineer of mines, 19; master of arts, 2; bachelor of arts, 8.

*LISBON TELEGRAPHIC CONFERENCE.*—The International telegraphic conference, which will be held in Lisbon, Portugal, beginning May 4, will have three representatives from the United States. These will be the Hon. Charles Page Bryan, United States Minister to Portugal; Mr. Roland R. Dennis, of the Department of Commerce and Labor, now located in Berlin, and a representative of the signal corps of the War Department.

*NEW YORK STATE REGULATION OF TELEPHONES AND TELEGRAPHS DEFEATED.*—The bill passed by the New York State Senate placing the telephone and telegraph under the jurisdiction of the Public Service Commissions was defeated in the House. The reason given by Speaker Wadsworth was that the passage of the bill would add unduly to the present work of the commissions. The influence of pool rooms was strongly exerted against the measure.

*NEW PLANT FOR GOLDFIELDS.*—The Nevada-California Power Company is installing an additional plant on Bishop Creek for the generation of electrical power for transmission to the southern Nevada gold fields, a distance of 120 miles. This will be the third plant on Bishop Creek, all using the same water. It will comprise three 2000-kw, 2200-volt, three-phase, 60-cycle, 300-r.p.m. generators, driven by overhung tangential waterwheels, supplied through a 48-in. pressure pipe 2800 ft. long, which in turn is supplied by a 48-in. wooden-stave conduit 10,000 ft. long. The working head is 860 ft. The voltage will be stepped-up by six 1000-kw transformers to 55,000 volts for transmission.

*CREOSOTES.*—Messrs. Arthur L. Dean and Ernest Bateman, United States government experts in the Forest Service, have written an excellent discussion of the analysis and grading of creosote, which has been published by the Department of Agriculture as Circular No. 112. This circular contains a large amount of experimental data and presents conclusions that will prove of value to those interested in the preservation of pole lines. The present circular covers in detail certain subjects not so fully treated in circular No. 80, previously issued, dealing with the fractional distillation of coal-tar creosote, since the publication of which laboratory work on the composition of creosotes has been continued, and a considerable quantity of data has been gathered.

*ELECTRIC TRUCKS FOR DOCKS.*—The New York Dock Company, which controls almost all the docks on the Brooklyn water front, has displaced the old three-wheeled trucks heretofore used for carting material from the steamships to the storehouses by electric trucks. The old trucks were pulled by horses and aside from the slowness with which the work was performed, the item of dock repairs owing to the cutting action of the horses' shoes was considerable. The electric trucks carry three times as much as the horse-pulled trucks and do the work much quicker besides reducing the item of dock repairs to a minimum. Storage batteries are used, and one charge is said to furnish enough energy to operate the truck 10 hours.

*GOVERNMENT ELECTRICIANS.*—The United States Civil Service Commission announces an examination on May 13, 1908, to secure eligibles from which to make certification to fill a vacancy in the position of electrician, $1,000 per annum, Quartermaster's Department at Large, Columbus Barracks, Ohio, and vacancies requiring similar qualifications as they may occur in any branch of the service. The duties of the specific position to be filled require thorough knowledge of and experience in house wiring, installation of electric lighting fixtures, and construction of pole lines; ability to read and test wattmeters and to care for and make slight repairs to transformers and arc lamps. The age limit is 20 years or over on the date of the examination. Applicants should apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any place where civil service examinations are held.

*WIRELESS TELEPHONY.*—Advices from Paris of April 11 say: "For the last few weeks the French War Office has been experimenting at the Eiffel Tower with the system of wireless telephony invented by Lee de Forest, and this fact has been made known through the cable dispatches. But the success of the experiments and their scope have just been published. Sets of apparatus were installed at the tower, in the Fort of Mont Valérien, and at Villejuif, a southern suburb of Paris. The experiment for telephonic communication between Villejuif and the Eiffel Tower succeeded excellently. Mrs. de Forest, using the apparatus at Villejuif, spoke quite easily to her husband at the Eiffel Tower, more than six miles away. By means of the apparatus at the Eiffel Tower and in Fort Mont Valérien, a conversation was carried on at a distance of three and a half miles with equal ease. The experiments were carried on before several officers of the French army and navy.

# Distribution of Niagara Energy in Auburn.

ALTHOUGH the longest transmission circuits in America are to be found in the Rocky Mountains, the fact remains that the longest distance over which energy is directly transmitted in this country is covered by circuits of the Niagara, Lockport & Ontario Power Company. These circuits serve for the direct transmission of energy 163 miles from the generating station of the Ontario Power Company, at Niagara Falls, while in the case of the long circuits in the Western States there are

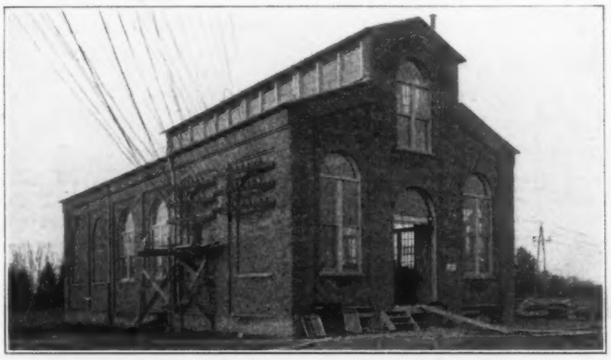


FIG. 1.—SUBSTATION, SHOWING ENTERING AND LEAVING WIRES.

connected to the same system several generating stations from no one of which is energy transmitted normally over so great a distance. The many engineering features of the above-mentioned 163-mile transmission system were described in our issues for April 14 and July 21, 1906, and they need not be discussed in this article, which deals with the distribution of the transmitted energy.

One of the most interesting secondary systems for distributing the energy transmited from Niagara is located at Auburn, N. Y., where substation apparatus has been installed to supersede and supplement steam-engine driven generating apparatus. This substation is owned and operated by the Auburn Light,

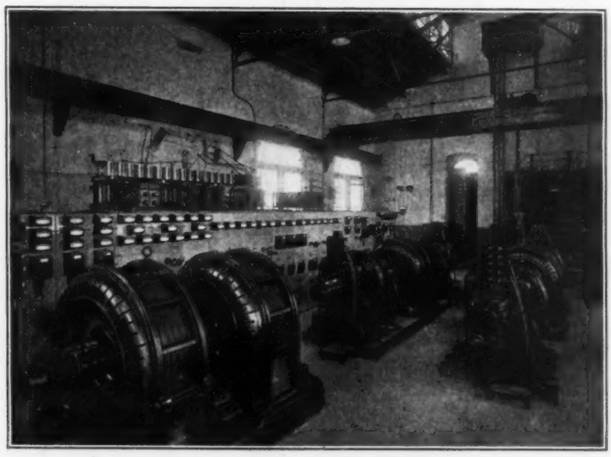


FIG. 2.—VIEW OF INTERIOR OF SUBSTATION.

Heat & Power Company, which conducts business under franchises granted to the old Brush-Swan Electric Company. This company purchases energy according to a system of charge based on one-minute peak loads, so that it is advantageous for it to maintain a high load factor. For this purpose it has retained a large portion of the early steam-engine driven equipment for use during the period of maximum load. The efficacy of this set in reducing the peak load and thereby increasing the load factor, as may be imagined, is of greatest value.

The substation building is placed just within the city limits so that no high-voltage circuits are erected within the populated district of Auburn. Energy reaches this building over a single three-wire, 50,000-volt circuit mounted on wooden A-frame poles, as shown in Fig. 1. This circuit is a four-mile branch which is joined by means of open-air fuses and air-break switches to the main line from Niagara to Syracuse. The main

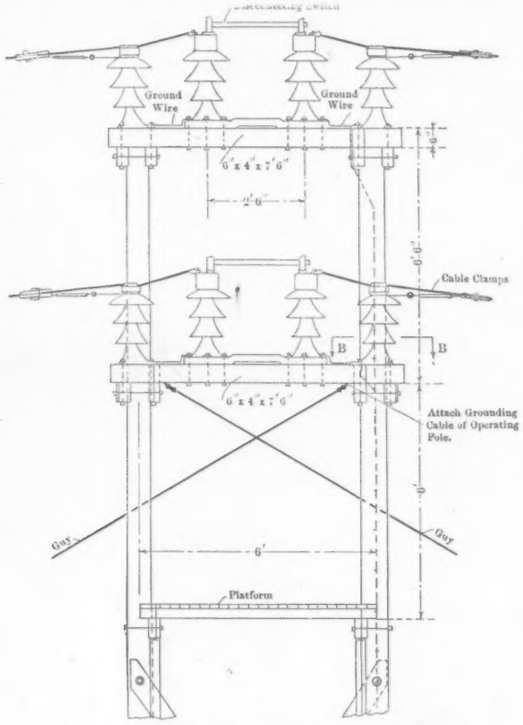



FIG. 3.—OPEN AIR DISCONNECTING SWITCHES.

line consists of two distinct circuits along separate routes; one of these is constructed of aluminum cables mounted on wooden A-frames along the West Shore Railroad, while the other consists of copper wires held on steel towers erected along private right-of-way. A view of open-air disconnecting switches on a double A-frame structure, a set of which is placed near the substation, is shown in Fig. 3.

The 60,000-volt circuits enter the substation building from sheltered line insulators through three tiles 4 ft. in diameter to insulators of the line type mounted within a special high-tension arrester and switch room. The lightning protection

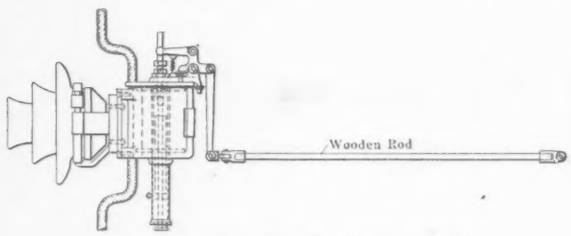



FIG. 4.—SELF-CONTAINED SERIES RELAY.

equipment consists of a star-connected low-equivalent arrester, the neutral being joined to ground through multigap arrester units. After passing through hour-glass shaped choke coils the circuit continues as 1¼-in. brass pipe, which is used for mechanical strength and presents a very attractive appearance, to a three-phase, 60,000-volt oil-immersed, motor-operated remote-control switch built into a special concrete structure.

An interesting detail of the high-tension circuits is the series relay, illustrated in Fig. 4, for opening the oil switch on overload. In this relay there are combined maximum simplicity and minimum cost. It consists of a solenoid acting upon a plunger magnet which moves a lever for opening (indirectly) the main oil switch when the current exceeds a predetermined safe value. The lever is made of wood and serves for insulating the relay from the switch mechanism, but no attempt is made to insulate the relay from the main high-potential circuit.

The lack of high-voltage insulation in the relay mechanism accounts for the simplicity and cheapness mentioned above.

In each high-potential line there is inserted one hook-type knife disconnecting switch, so that each element of the three-pole oil-switch may be isolated in case repairs become necessary. The so-called "motor-operated" switch is, in fact, operated by springs which are released by trips, the motor serving merely to store energy in the springs. Thus a failure of the motor would not prevent the switch from being opened under overload. Moreover, the switch can be closed by hand in case of necessity. The central switch for operating the motor is mounted on the main switchboard described later, and energy for driving the motor is obtained from a storage battery.

The high-tension circuits terminate at the primary leads of three 500-kw transformers, Y-connected; the secondary coils of these transformers are △-connected and deliver energy to the main substation busbars at 2300 volts. Each of these transformers, which is located in its own concrete cell, is placed on a wheel-truck so that it may be disconnected from service and replaced by a similar transformer which is kept in a fourth cell as reserve. The secondary coils of the transformers are provided with a mid-voltage point so that synchronous motors may be started from rest at half-voltage.

A partial view of the interior of the machine room of the substation is given in Fig. 2. There are three 300-kw, 25- to 60-cycle frequency changers, each driven by a 2300-volt synchronous motor. The machines are started from rest by impressing one-half voltage across the armature circuit, as intimated above.

The substation equipment includes also six 6.6-Brush arc machines, each designed for operating 125 lamps in series. These machines are driven in pairs, through rubber-compression couplings by three 2300-volt motors. Two of these motors are of the synchronous type, rated at 150 kilowatts, and arranged for starting at one-half voltage. The third motor is a 200-hp induction machine provided with a coil-wound rotor so that resistance may be inserted during the starting period.

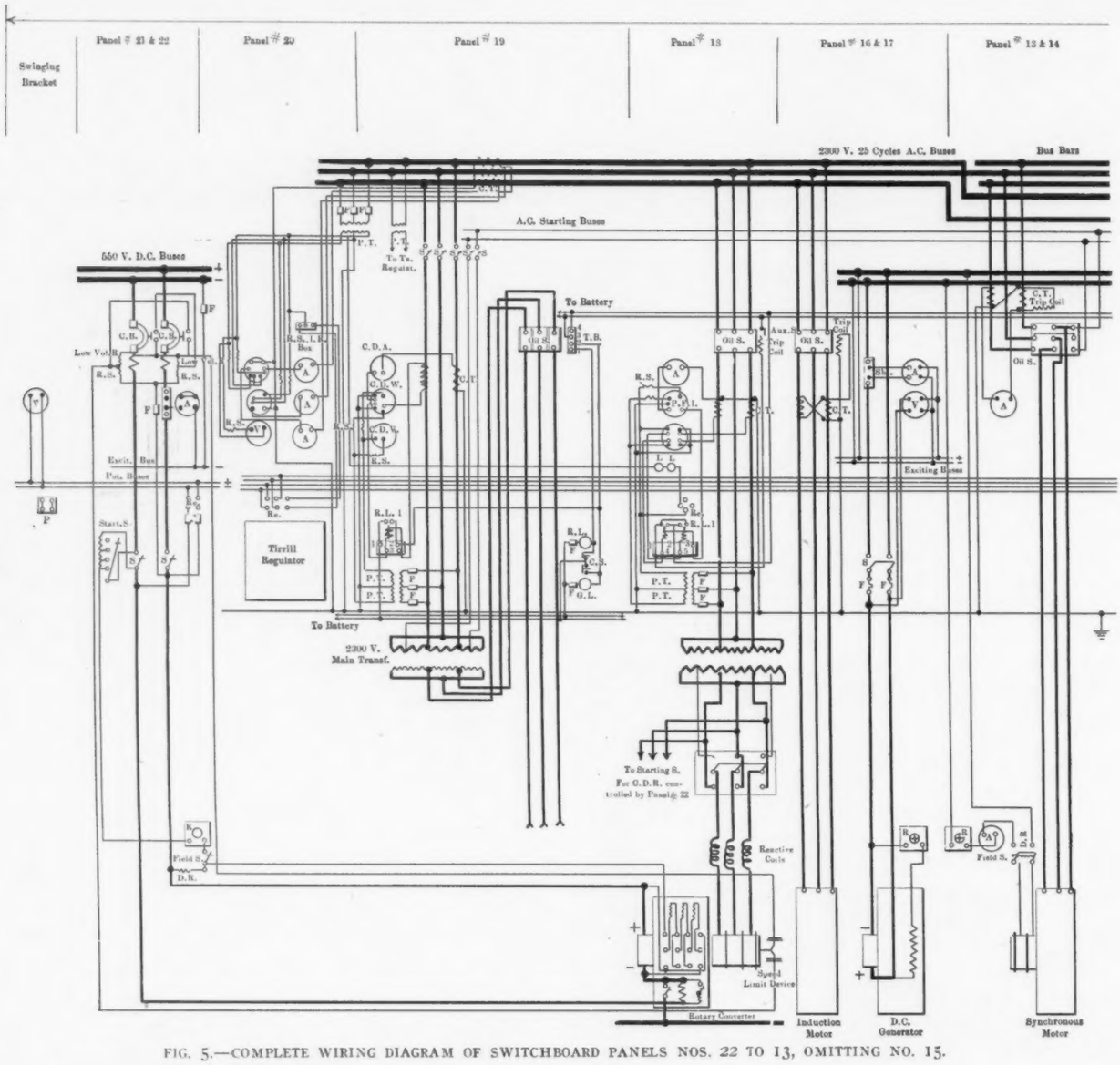



FIG. 5.—COMPLETE WIRING DIAGRAM OF SWITCHBOARD PANELS NOS. 22 TO 13, OMITTING NO. 15.

The direct-current apparatus consists of a 50-kw, 125-volt exciter direct-connected to a 2300-volt induction motor, a 30-kw Edison bipolar generator held as reserve for excitation, and a 200-kw, three-phase rotary converter for supplying energy to 500-volt, direct-current motors. The converter receives its energy from three delta-connected 2300-volt to 360-volt transformers, and is started from rest at half-voltage obtained from central taps on the secondary coils of two of the transformers.

For the operation and control of the substation machinery there has been installed a 22-panel blue Vermont marble switchboard, as shown in Fig. 7. The most prominent feature of this board is its simplicity, which has been obtained by locating all rheostats overhead, and all 2300-volt circuits in the

cellar below. The rheostats are operated by means of chain gearings and the main circuit switches by lever systems.

A Tirrill regulator serves for maintaining the voltage delivered by the 60-cycle generators at the desired value. On account of the presence of the synchronous motors and converters, the power factor of the load on the transmission system is wholly under control of the substation operator. The power factor is kept quite high, but no attempt is made to draw leading wattless current. In fact, it is recognized that stability of synchronous apparatus is best obtained by allowing the machine to draw a lagging current. No trouble whatever has been experienced with the synchronous machines during either the starting or the running period.

A complete diagram of the circuits of the substation apparatus, as viewed from the rear of the switchboard, is given in Figs. 5 and 6. On this diagram panels that are in duplicate are represented by a single panel. Energy reaches the board over 2300-volt busbars at 25 cycles and is distributed from the board directly at 2300 volts, 25 cycles, and over 2300-volt, 60-cycle and 300-volt direct-current busbars. The arc-lamp circuits are connected to a special distributing board, not indicated in Figs. 5 and 6.

The company has connected to its circuits 524 municipal arc lamps, for each of which it receives $68 per year. About one-sixth of these lamps are run on an all-night schedule, while the others are extinguished at 1 o'clock. It also operates a number of commercial arc lamps, 15 of which are effectively arranged over the center of the sidewalk along one block. The company has conducted an energetic and effective campaign to increase its commercial load and has secured contracts for illuminating a large number of signs and display windows.

The average 24-hour load on the whole system is about 350 kilowatts, while the maximum one-minute peak is kept slightly less than 700 kilowatts, so that the load factor on the substation exceeds 50 per cent. The reserve steam station, which assists during the peak load, has already been mentioned.

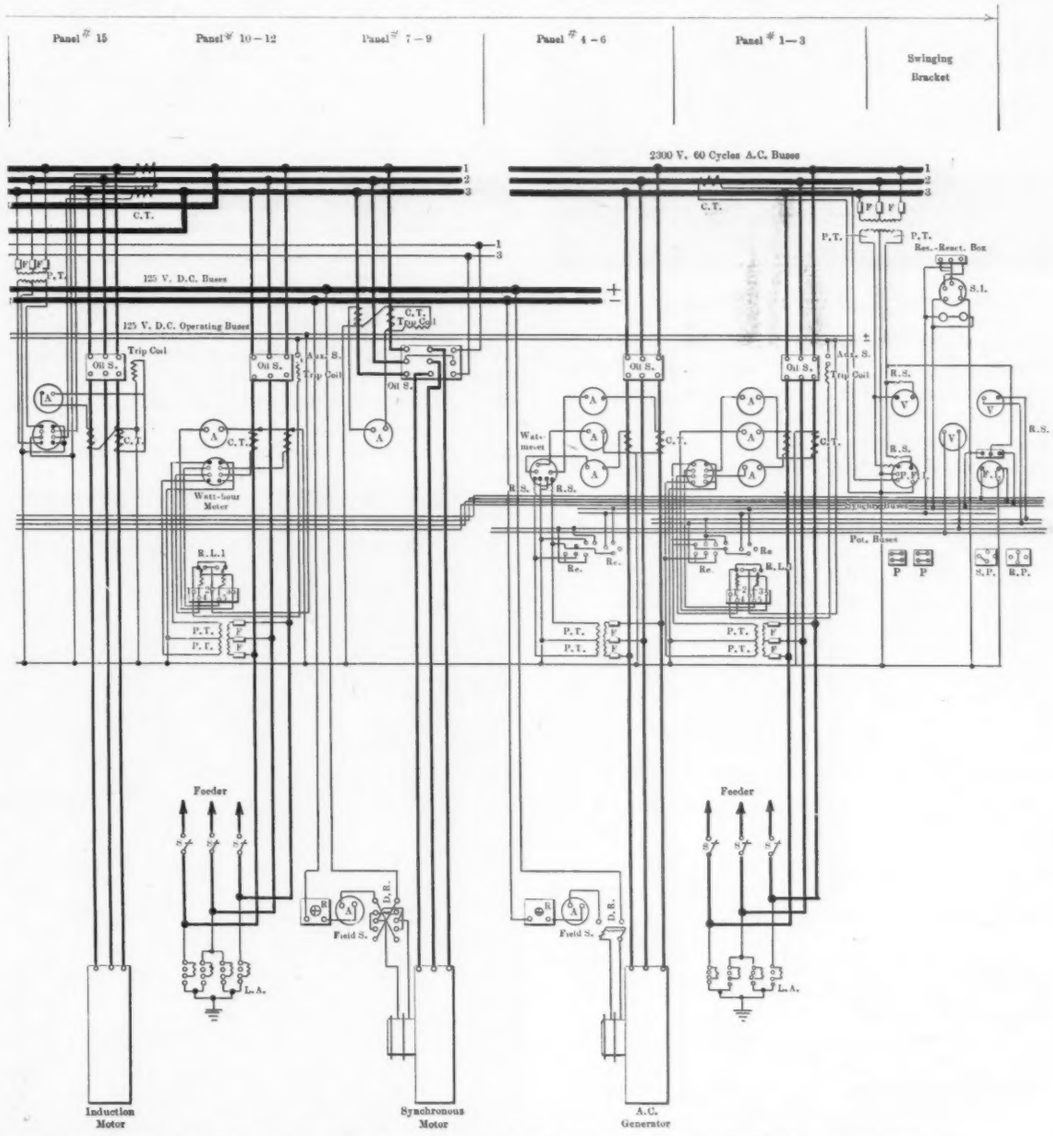



FIG. 6.—COMPLETE WIRING DIAGRAM OF SWITCHBOARD PANELS NOS. 15 TO 1, OMITTING NOS. 13 AND 14.

This station contains a 500-kw, 60-cycle, 2300-volt alternator directly connected to, and mounted between, two Lake Erie vertical cross-compound condensing engines. Steam is taken from the exhaust of the high-pressure cylinders for use in a heating system which the company maintains in the business portion of the town. Since there is always a demand for steam heat during the peak of the electrical load, the arrangement employed gives very satisfactory results. It has been found that almost no additional coal is required to supply energy to the generator than is necessary to furnish merely the live steam for heating. In other words the high-pressure cylinder is used simply as a reducing valve. The amount of load taken by the engines can be governed by the admission of steam to the low-pressure cylinders, so that by regu-

lating the valves in the steam-heating main and the low-pressure cylinder, sufficient load can be taken to give the required pressure on the steam main. Since the generator runs in parallel with the other machines, its load can be varied at will.

The Auburn Light, Heat & Power Company is owned by the American Gas & Electric Company, of which Mr. H. L. Doherty, of New York City, is president and Mr. H. T. Hartman, of Philadelphia, is vice-president and general manager. The superintendent is Mr. M. C. Turpin, under whose direction the improved apparatus has been installed. Mr. J. S. Wise, Jr., of Hazleton, Pa., formerly superintendent, acted as consulting engineer in connection with Mr. Hartman. The electrical equipment has been supplied by the General Electric Co.

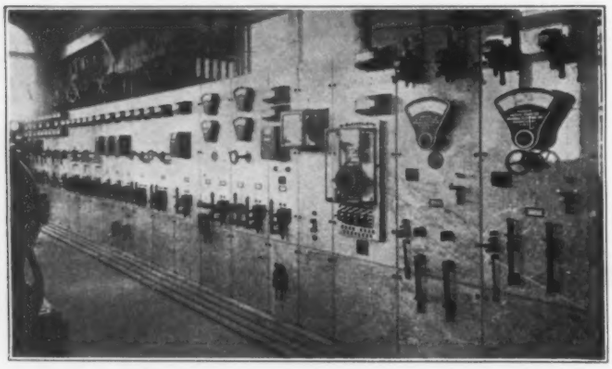


FIG. 7.—MAIN SWITCHBOARD IN SUBSTATION.

## The Lighting of a Small Chicago Church.

The lighting of St. Paul's Evangelical Church, at Beverly Hills, a suburban district in Chicago, was recently overhauled and presents some new features of interest both to illuminating engineers and architects. In fact, it is a good practical example of the benefits to be derived from illuminating engineers and architects working in full harmony and co-operation with each other. The church is a small one, the floor dimensions being given in the drawing, Fig. 1. Consideration was at first given to the possibility of concealing lamps in box fixtures so that no direct rays could fall in the eyes of the audience. It was found, however, that in order to carry out this scheme properly a number of fixtures would have to be provided which would not look well in such a small church. The construction of the church seemed to call for a large central fixture. It was, therefore, decided to design a large wooden fixture which would be in keeping with the general interior finish and design. The design of this fixture and that of the choir-board, to be described later, were suggested and carried out by Mr. H. K. Holsman, architect of the church, in such a manner as to be entirely in keeping with the rest of the structure and in conformance with the requirements of the illuminating engineer.

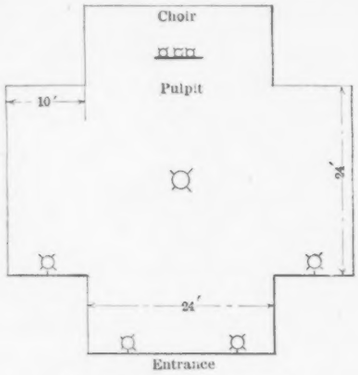



FIG. 1.—PLAN OF CHURCH.

This wooden fixture is shown in Figs. 2 and 3. It presents several advantages over a metal fixture in this case. It is more in harmony with the church interior than any metal fixture which could have been obtained at a price which would have been within reason for such a small building. Its finish corresponds with that of the rafters and ceiling. It was easy to make it of sufficient size so that it would not seem to be out of proper proportion. Its size also made it possible to obtain two advantages from an illuminating standpoint. One of these is that the lamps are brought nearer to the side wings, which receive part of their light from this chandelier, and the other reason is that the 48-cp lamps, with which this chandelier is equipped, are less trying to the eye if scattered over a large chandelier like this than if placed in a more compact cluster.

Inasmuch as it was not possible completely to screen the lamps from the eyes of the audience, the next best course was adopted, namely, to use frosted tip lamps and place them in deep bowl reflectors enameled white on the outside. The lamps are tungsten, of 48 candle-power, with frosted tips. The Holophane enameled bowl reflectors used are of a size larger than that usually specified for 48-cp tungsten or 40-cp Gem lamps. This larger size was selected in order more completely to cover the lamp than would the size commonly used with this lamp. The enameling of the bowl reflector, together with the frosting of the tip of the lamp, beautifully diffuses the rays so as to produce a handsome appearance and the minimum injurious effect on the eye. It is not as good for the eye as having the lamps entirely concealed, but is a fairly effective compromise, giving both good diffusion and fair efficiency. The loss of efficiency due to the enameling (if considered on the basis of the flux of light downward within a zone 73 deg. from the vertical) is estimated to be from 15 to 20 per cent.

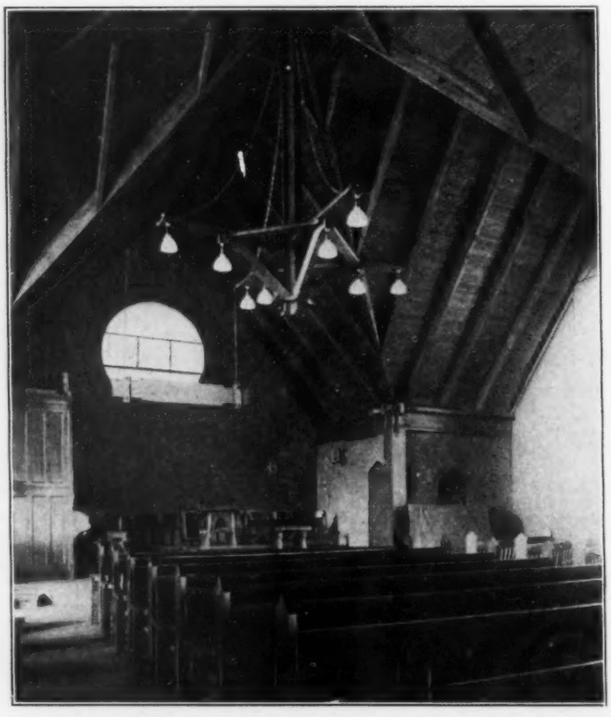


FIG. 2.—WOODEN CHANDELIER AND CHOIR LAMP SCREEN.

The lighting of the choir presented another problem which, at first, seemed difficult, since it was desired to conceal the sources of light altogether from the eyes of the audience and at the same time give ample illumination on choir and organ. Furthermore, since the organ is soon to be moved into an alcove which will be built back of the pulpit, the scheme had to be adapted both to the present position of the organ and to its future position. The architect came to the rescue with a plan which seemed at first rather radical, but which worked out to the satisfaction of all concerned, and is in full harmony

with the surroundings. A board suspended in wooden slings is hung by chains 7 ft. from the wall, as shown in Figs. 2 and 3. Behind this board were placed three 40-cp lamps with prismatic reflectors. A section through this board and one of the lamps is shown in Fig. 4. The lamps are entirely invisible from the audience and there is a flood of light for the choir and organist. The lantern fixtures seen in Figs. 2 and 3 are part of a former

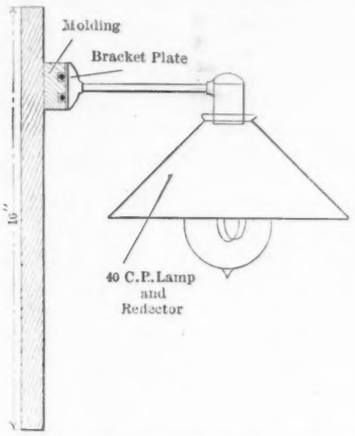



FIG. 4.—SECTION THROUGH BOARD OVER CHOIR.

lighting scheme, which has been abandoned because of its inefficiency, and because of the location of the lamps where they could not be avoided by the eyes of the audience. The cost of the two wood fixtures complete, ready for use, not including lamps or reflectors, was about $50. Of this, half was for the mill work and assembling, and the remainder for iron chains, electric wiring and supplies, and hanging and staining the fix-

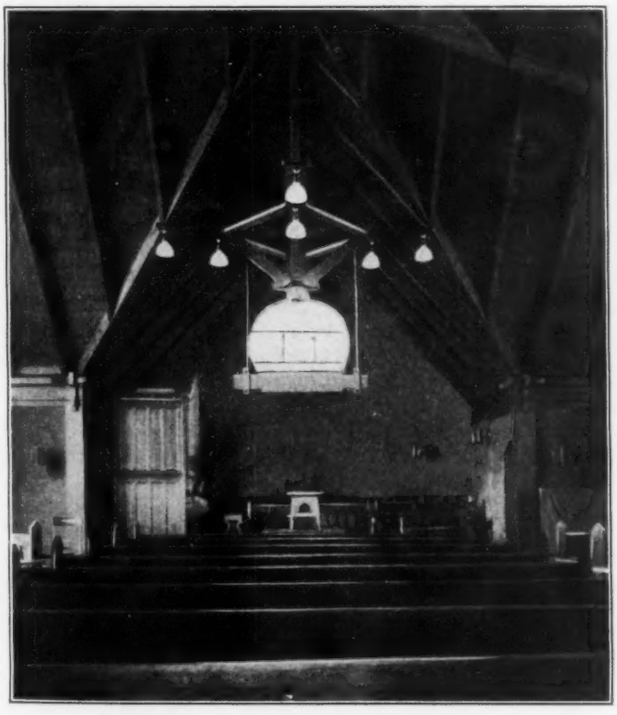


FIG. 3.—WOODEN CHANDELIER AND BOARD OVER CHOIR.

tures. The fixture is of pine stained to match the other woodwork. The arms have a spreak of about 9 ft. The height of the lamps is about 14 ft. The lighting from the central chandelier is supplemented by lights on the rear walls of the wings and main part of the church. The total area of the church is 1536 sq. ft. To light this area there are 480 watts expended in the tungsten lamps on the central chandelier, and 700 watts in Gem lamps behind the choir board and on the rear wall. The total wattage is, therefore, 1180, or 0.77 watt per square foot. The illumination is ample to suit the most exacting, and the users are well pleased with the general effect.

## Capitalization of Public Utilities.

BY CHAS. M. BROWN.

The quotation from the last report of the Interstate Commerce Commission in Mr. W. H. Winslow's article in the first issue of April states in official language a condition and not a theory. The quotation is: "We are aware that in the construction of new lines of railway, developing new territory, it has been necessary in many instances to sell railway securities at large discount and to sell bonds with stock bonuses, and, even in such cases, it has many times been difficult to raise the necessary capital."

To this quotation one might well add: "Furthermore, it will undoubtedly continue to be more than difficult to raise capital by other than these means for new ventures, for extensions and for rehabilitations, if the public is to secure the extension and improvement of service which is desirable at the minimum increase in fixed charges and hence at the minimum 'investment charge' in the rates."

But how contrary to popular belief it sounds to say that by stock watering the extension and improvement of public services is obtainable at the minimum increase in the "investment charge."

This raises the basic question involved in the regulation of the capitalization of public utilities. Assuming any given equipment and service, are the public, and especially the patrons of the service, most interested in having the par value of its securities not exceed its tangible assets, or are they most interested in having the total annual capital charges due to necessary investment for equipment and other facilities as small in amount as possible and hence but a minimum item in the costs making up the rate for service? Obviously their interest is primarily and directly in having the rate for a given service as low as possible. Other things being equal, this end is attained by having the amount of the annual capital charges as low as possible. Those of the public who are or may be users of the service are, therefore, interested in the question of capitalization only insofar as it may now or in the future affect the amount of the annual capital charges and the rôle they play as an item of the rate for a given service. Therefore, any legitimate means which will secure the investment money necessary for equipment and facilities for the smallest amount of annual capital charge now and in the future will best serve the public interest.

The popular theory is that only by limiting the par value of a given capitalization to an amount equal to the capital money put in can the value of the property be determined and the amount of annual capital charges kept down to a minimum commensurate with the investment. So popular interest is centered on the par value of capitalization instead of on the amount of annual capital charges, and without regard to the fact that the ways and means taken to prevent "stock watering," while keeping down the par value of capitalization, raise the amount of annual capital charges necessary to induce any investment and militate against the ready obtaining of additional money for investment whenever necessary.

That the theory that thus limiting capitalization makes it possible to see at a glance the value of a property is contrary to the facts is well shown by the present conditions of the public lighting companies in Massachusetts. There it has been applied for many years and has resulted in an extraordinary state of affairs. Presumably its object was to prevent values appearing as greater than investments. Practically its effect has been to reduce the total par value of securities very much below the investment they represent and which their sale secured. Thus, instead of the securities of a company indicating in their par value its tangible assets plus its present or prospective intangible assets or its total fair value, as is the usual commer-

cial practice, the par value of Massachusetts public-lighting companies' securities usually represent but a fraction of their fixed tangible assets and do not in any way on their face allow for any intangible value. In fact, more than one instance exists where the par value of a company's securities is but one-half the cost and value of its fixed tangible assets, and where the total fair value of the company as a going concern is about three times the par value of all of its outstanding securities.

With such conditions as the result of arbitrarily limiting the par value of capitalizations, as shown in the only State where these theories have for a period of years been worked out to their inevitable conclusions, it is obviously impossible to look to any arbitrary method of limiting capitalizations as an automatic means of indicating values.

The second purpose of this theory, as previously suggested, would seem to be to keep down to a minimum the amount of the annual capital charge necessary to induce the investment of a given amount of money. Experience has shown that if the par value of capitalization is to be limited not to exceed the amounts of money actually invested, not only must securities never be disposed of below par, but also in the ordinary course of business relative equity to original and subsequent issue of securities demands that the latter be sold at some upset price above par.

To illustrate how this works, assume that a hundred dollars of capital is needed for which one share of $100 par value is issued and on which dividends are payable at the rate of 10 per cent or in the amount of $10 per annum. Observation of the idiosyncrasies of the investing public, the court of last resort for all investments, shows that it will practically without exception pay relatively more for low-priced, low-interest bearing securities than for high-priced, high-interest bearing securities. If one $100 share paying $10 per annum will sell for $100, two $100 shares each paying but $4 per annum would probably sell for at least $50 each. In other words, if we disregard the par value fallacy, which is the popular cry, $100 can be obtained at an annual cost of $8 instead of $10. And this is shown by the history of sound underwritings and reorganizations.

It would seem that failure to recognize these simple conditions has led to this fostering a system for capitalizing public utilities and obtaining the money needed in their equipment by the requirements of the public for service which militates against this investment money being obtained in the cheapest way.

But at this point it may be objected that while selling low-rate securities below par may be the cheapest way of meeting present needs for capital money, it is but mortgaging the future, since some day every share of stock of the par value of $100 sold for $50 and paying only $4 as interest will claim to be worth $100 and to be entitled to receive at least $6 as interest. It is obviously perfectly natural that these latter conditions should arise where public service companies are not subjected to continuous and detailed public supervision and control of an enlightened nature, but they are entirely unnecessary where such supervision exists.

If legislators and supervising commissions were to address themselves directly to the main feature affecting the rate for service in the capital question—the amount of annual capital charges currently necessary to secure the investment of any given amount of capital—instead of trying to reach this by the circuitous and inefficient means of limiting the par value of capitalizations, great improvements, both in public services and in their financing, might be expected.

Frankly admitting, as every clerk knows, that par values of securities have nothing to do with values and may understate values as well as overstate them, public supervisory officers should rather consider in detail the amounts of investment money represented at least in part by outstanding securities and the amounts of annual capital charges necessarily and properly payable for the investment and use of this money. Regulation and control of the relation of the total fixed charges or contractual payments and earnings to the amount of money invested would directly accomplish the end indifferently attained and with very great drawbacks by limiting capitalization. Untrammeled, the latter could then be adjusted to best meet the money market conditions, to obtain the maximum amount of investment money at the cheapest net rate.

Moreover, investors would undoubtedly be more inclined to buy low-priced public lighting securities at a present very low net rate of return if assurance was given that the return on these would increase in the future by the operation of some logical device like the "London Sliding Scale." Nor could the public object to such future increase in return when realized, as it would be, but the just reward coming to the company for cheapening and extending its service of the public.

## Central Station Notes from Atlanta.

One of the most active central station business organizations in the South is that of the Georgia Railway & Electric Company of Atlanta. This company serves a population of about 150,000, its territory including Atlanta, Oakland City, Fort McPherson, East Lake, East Point and Decatur. The area of the district covered by the company's lines is about 15 sq. miles. On the first of this year the company's total connected load was 154,964 16-cp lamps or their equivalent, 1063 7.5-amp. series arc lamps, 518 series incandescent lamps, 1541 commercial arcs of the 5.5-amp. size, 4239 hp in direct current motors, and 2215 hp in alternating motors, with 289,795 sq. ft. of radiation on the mains of the steam heating system operated by the company.

The officers of the company are, president, Mr. P. S. Arkwright; vice-president and manager, Mr. G. W. Brine; secretary, Mr. W. H. Glenn. The operation of the system is under the jurisdiction of Mr. S. A. Redding, and the sale of light, heat, and power, with the supervision of the meter department, is under Mr. W. R. Collier. The company occupies a handsome office building of its own in the heart of the business district, the contract department being on the street floor with the gas and cashier's offices. On the upper floors are the executive offices and the engineering department. The inside furnishings of the building are of the permanent and substantial character found in banking houses. Liberal space was allotted on the first floor for the exhibition of new appliances in both the electric and the gas fields.

The power rates of the company begin with a 2-hp motor, the charge for the first 75 kw-hours being 6 cents, and all consumption in excess of this is at the rate of 3 cents. This charge for the different sizes of motors up to 10 hp continues with a variation in the number of kw-hours that apply to the higher rate per unit, so that at 5 hp the first 275 units are billed at 6 cents and at 9 hp the first 435. With a 10-hp motor the first 465 units are billed at 6 cents and all in excess of this at 2 cents. With a 25-hp motor the first 700 kw-hours take the 6-cent rate and the rest are billed at 2 cents. There is a net guarantee of $1 per horse-power per month. A discount of 10 per cent in allowed inside of 10 days from the date of the bill.

The lighting rate for an installation of from one to fifty 16-cp lamps is 10 cents for the first 150 kw-hours, with the excess at 6 cents. The primary rate of 10 cents holds as the size of installation increases, but the number of primary kw-hours gradually decreases in proportion to the connected load, so that with from 300 to 400 lamps connected, the first 800 units receive a rate of 10 cents, and the excess above this a rate of 6 cents. The minimum guarantee is $2 net per month up to 20 16-cp equivalent; above this 10 cents net is added for each 16-cp equivalent.

The sale of current for electric signs is on a flat rate, the charge being 15 cents per lamp per month, the lamps being of 2 cp each. This figure includes renewals. The purchaser buys the sign and puts on an automatic time switch. The signs usually burn four hours per night. Fans are put on a power rate and are rated at 1/5 hp per fan.

The company has installed a large number of Gem lamps in 50, 75 and 100-cp sizes, and it renews these free. Last year 513 electric flat irons were sold, weighing from 3 to 8 lb. The total con-

nected heating load on electric circuits is now about 300 kw. Electric cooking devices are in use in two restaurants on the company's lines. Two notable electric heating installations are in binderies, where 18 kw of connected load are in service. There are 16 heaters in these establishments and the peak load of the concerns comes from 6.30 to 7 a. m. daily. This amounts to about 30 kw. The peak consumption is required to heat up the glue baths for the run of the day, and after the first heat is accomplished a low heat is run the rest of the day until 6 p. m., when the establishment shuts down for the night. This is a very desirable class of off-peak business.

In the power field the company has about half a dozen refrigerating-plant customers whose loads connected vary from 2 to 25 hp. Other power users of prominence are the J. K. Orr Shoe Company, 70 hp; the Dowman-Dozier Mfg. Company (tin and metal), 42 hp; the Kimball House, 117 hp; the Piedmont Hotel, 155 hp; Schlesinger-Meyer Bakery, 93 hp; Southern Spring Bed Company, 91 hp; *Sunny South* Publishing Company, 83 hp (individual motor drive); *Atlanta Constitution*, 103 hp; *Atlanta Journal*, 175 hp; National Duck Mills, 75 hp; Southern Saw Works, 80 hp; Atlanta Agricultural Works, 80 hp. The largest single-phase motor allowed on the company's lines is 5 hp.

The central portion of the city is supplied with steam heat from the company's power plant on Butler Street. There are about 156 customers for this service, which extends from Nov. 1 to May 1. Both flat and meter rates are in use by the company. To secure a meter rate a customer must have at least 400 sq. ft. of radiation. The minimum rate must exceed $8 gros per month, based on 200 lb. of steam condensed per sq. ft. of radiating surface per season at 80 cents gross per thousand pounds. The resulting rates are as follows:

80 cents per 1000 lb. for first 10,000 lb. per month.
70 cents per 1000 lb. for next 10,000 lb. per month.
60 cents per 1000 lb. for next 10,000 lb. per month.
55 cents per 1000 lb. for next 20,000 lb. per month.
50 cents per 1000 lb. for next 20,000 lb. per month.
45 cents per 1000 lb. for next 30,000 lb. per month.
40 cents per 1000 lb. for all above 100,000 lb. per month.

The flat rate is based on 600 lb. condensation per sq. ft. per season on the above scale. The company guarantees 1 lb. pressure at the service. The system is that of the American District Steam Heating Company and the pressure at the power plant averages about 9 lb. The distribution system consists of an interconnected set of mains starting from the Butler Street plant as a 14-in. and a 16-in line, and carried under the principal streets of the downtown district.

## Electrical Developments at Chattanooga, Tenn.

Chattanooga, with its magnificent factory sites and superior railroad facilities, has been growing rapidly as a manufacturing center for some years and the promise of the completion of the Tennessee River water power development at Hales Bar, 12 miles from Chattanooga, within two years, promises a still more rapid future growth.

The Chattanooga Electric Company, which controls the present central-station lighting and power business, rebuilt its steam plant in 1904 and installed 2000 kilowatts in 2300-volt, 60-cycle, three-phase Curtis turbo-alternators, high-pressure water-tube boilers with superheaters, Worthington condensers and a system of spray nozzles for cooling circulating water. Since that time the capacity of the plant has been doubled and plans for a further increase are now under way. This rapid development, while largely to keep pace with the rapid growth of its lighting business, is in a greater degree due to the power requirements of its customers.

The largest customer is the Chattanooga Electric Railway Company, operating the consolidated railway lines, and 2300 kilowatts of direct-current power are now supplied through rotary converters, entirely from the electric company's station. As high-tension distribution will be more economical, substations will be established by the railway company to meet its growing demands.

While there is a direct-current, 500-volt power circuit in the retail section, the principal power customers are on the special three-phase high-tension circuits. The largest customer at this time is the American Brake Shoe & Foundry Company, which requires 300 horse-power.

The policy of the company is to take all new business on a combined service and meter rate. Very little difficulty is experienced in demonstrating to customers that the company can make the lowest possible rate in this manner. The general rate is $18 per hp-year on the customer's demand and 2½ cents per kw-hour for actual consumption of energy, but a reduction is made in the service charge for off-peak use and in the meter rate for wholesale use, the maximum discounts reaching 30 per cent. The average cost per annum to all power customers on the December, 1907, figures is under $20 per horse-power connected.

The company has given its lighting customers the benefit of reduced operating costs, and on May 1, 1907, reduced the rates for lighting to 12½ and 6½ cents per kw-hour, less a 5 per cent discount for prompt payment within 15 days. The high initial rate is charged for the first kw-hour per month per 25 watts of connected load, and beyond that the lower rate goes into effect. This is subject to general rules modifying the application to residence lighting. A considerable amount of flat rate sign, window and outline lighting is in use. About 60 signs are in use, many of which contain several hundred lamps each.

The manufacturing interests of Chattanooga are ably represented by the Chattanooga Manufacturers' Association, having some 130 individual members and listing some 240 different manufactured articles. This organization in its general care for the interests of members is greatly interested in the cost of power, which recently led the Chattanooga Electric Company to propose a series of tests of steam plants by outside parties, representative manufacturing plants to be picked by the association. The proposal was accepted and seven factories named.

Arrangements were made with Professor Ferris, of the University of Tennessee, to supply a corps of professors and students for the work, and the tests were made during the month of October. The manufacturers, in their anxiety to have a good load, planned, in most cases, to work their factories at greater than the average output and thus considerably lessened the apparent cost of power per hp-hour through a material improvement in load factor. The actual cost of plant, the labor, oil and waste and engine-room supply figures were not in most cases available at the time of the test and were generally estimated. Slide-valve engine plants with return tubular boilers were estimated to cost $30 per indicated horse-power, and high-grade Corliss engines, with water-tube boilers, etc., $60 per indicated horse-power. Interest was figured at 6 per cent, depreciation 5 per cent, repairs 1½ per cent, insurance and taxes 2½ per cent, making a total annual charge of 15 per cent for these items. In the plant showing the lowest cost there was an item of slabs from a saw-mill on the premises and a large steam pump which could not be indicated, bringing in elements of uncertainty.

It is a matter of general regret that actual figures on cost of plant, repairs, labor and supplies were not available for the original report, and that the operating conditions were not more normal to add to the commercial value of the data, by showing more closely the actual operating costs. It is hoped the tests may be repeated at a future date with such figures available, but in the meantime the results obtained, while indicating a possible minimum cost, are of great practical value. The figures which were given to the local press in Chattanooga and were published in circular form by the Manufacturers' Association, are given in the accompanying tabulation, omitting the names of the plants tested.

It should be borne in mind that the costs are in indicated horse-power and that engine, dynamo and belt and shaft transmission efficiencies should be taken into consideration for comparison with electrical power for distribution to individual motors. In the case of the plant showing the lowest cost per indicated horse-power in the table, the annual cost per switch-

board kilowatt for 10½ hours, 300 days per year, is given in the report as $40.

In this connection it may be well to call attention to the fact that ordinary central-station conditions of service involve a reserve capacity equal to the largest unit regularly in service, which in a private plant means 25 to 50 per cent and sometimes 100 per cent or more increase per indicated horse-power on

| Boilers and Engines | Water Tube, 145 lbs. Pressure, and Corliss, 20 x 36, No. 1. | Water Tube, 145 lbs. Pressure, and Corliss, No. 2. | Return Tubular, 87 lbs. Pressure, and Corliss, 16 x 30. | Return Tubular, 110 lbs. Pressure, and Corliss Type, 24 x 48. | Return Tubular, 100 lbs. Pressure, and Corliss, 22 x 46. | Return Tubular, 95 lbs. Pressure, and Slide Valve, 11 x 13. | Return Tubular, 80 lbs. Pressure, and 2 Slide Valves, 10 x 10 and 10 x 12. |
|---|---|---|---|---|---|---|---|
| Length of run | 10½ hours | 24 hours | 10.6 hours | 12 hours | 9¾ hours | 10.16 hours | 9.51 hours |
| Av. r.p.m. | 118 | 93.3 | 120 | 79 | 70 | 154.5 | 150.3—159.1 |
| Av. mean eff. pressure h. e. | 51.7 lbs. | 42.2 lbs. | 38.8 lbs. | 49.36 lbs. | 30.7 lbs. | 17.2 lbs. | 18.6—10.5 lbs. |
| Av. mean eff. pressure c. e. | 50.3 | 38.9 | 34.3 | 49.91 | 30.2 | 17.5 | 18.99—10.20 lbs. |
| Total horse-power | 340 | 201.1 | 131.8 | 422 | 193.9 | 16.6 | .... |
| Total hp. hours developed | 3,570 | 4,366.6 | 1,395 | 5,107.6 | 1,890 | 107.5 | 183 |
| Total coal used | 10,683 lbs. | 13,751 lbs. | 5,304 lbs. | 19,423 lbs. | 12,020 lbs. | 2,194 lbs. | 2,696 lbs. |
| Coal charged to engine | 9,180 | .... | 4,691 lbs. | .... | 10,680 lbs. | .... | .... |
| Coal used per hp. per hr | 2.57 | 3.15 | 3.56 | 3.85 | 5.6 | 13.1 | 14.7 |
| Cost of coal per hp | 3½ cents | .... | 3.8 cents | 4½ cents | 5 cents | 9.6 cents | .... |
| Total ash | 461 lbs. | 2,229 lbs. | 490 lbs. | .... | 2,426 lbs. | 492 lbs. | .... |
| Per cent ash | 4.3 | 16.2 | 9.24 | .... | 20.2 | 22.5 | .... |
| Total water used | 85,000 | .... | .... | .... | .... | .... | .... |
| Apparent evap. per lb. coal | 7.93 | .... | .... | .... | .... | .... | .... |
| Eff. of engine and dynamo | 81 per cent | .... | 72 per cent | .... | .... | .... | .... |
| Cost of hp. per year | $24.15 | $45.00 | $26.88 | $25.48 | $28.90 | $68.62 | $75.14 |

the investment charges; while by doing away largely with belting and shafting it was estimated in one of these tests the demand for power would be cut down over 40 per cent.

The staff of the Chattanooga Electric Company is Mr. W. E. Boileau, general manager, and Mr. F. W. Lawrence, general superintendent. The new business department is in general charge of Mr. R. C. Holley, and Mr. C. T. Reiss is in general charge of power soliciting.

## Direct Current Motors—Their Action and Control—VII.

By F. B. Crocker and M. Arendt.

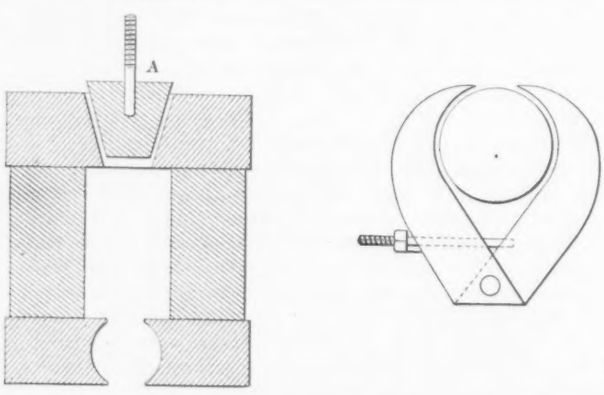
The article in the first issue of April dealt with the problem of shunt-motor speed control by variation of the field-exciting current; this article is descriptive of those methods of speed regulation which depend upon the *variation of the reluctance of the magnetic circuit*, being based upon the fundamental fact that:

$$\text{flux} = \frac{\text{magnetomotive force}}{\text{reluctance}}.$$

Thus, if the m.m.f. be maintained constant and the reluctance be varied, we obtain a variable flux, and because $\text{r.p.m.} = \frac{e\,10^8\,60b}{\phi n 2p}$ it is evident that the speed varies inversely as the flux ($\phi$). Among the earlier methods tried were those of T. A. Edison and the Diehl Company.

*Edison's Variable Reluctance Method.*

The reluctance of the magnetic circuit in this instance was varied as shown in Fig. 1 by decreasing the amount of metal in the yoke of the machine, the wedge-shaped piece, *A*, being raised, thus decreasing the total flux. The range of speed is not very great, as excessive sparking develops when the field is weakened because there is no feature of design to prevent flux distortion. This method was primarily intended for voltage regulation in connection with generators, and is of historical rather than commercial importance.




FIGS. 1 AND 2.—METHODS OF VARYING RELUCTANCE OF THE MAGNETIC CIRCUIT.

*The Diehl Method.*

In this instance the flux reduction was obtained by lengthening the air-gap, the pole pieces which were mounted on hinges, being moved away from the armature as indicated in Fig. 2. This construction was not very successful and was, like the preceding one, originally intended as a means of regulating the voltage of generators.

The two modern methods of speed control by variation of reluctance are those of the Stow Electric Company and the Lincoln Manufacturing Company.

*The Stow Variable-Speed Motor.*

This design* also depends upon the removal of iron from the magnetic circuit, the pole cores being made hollow and provided with iron or steel plungers, the position of which is adjustable through worm gears and pinions operated by a large hand-wheel. (Fig. 3.) When the plungers are with drawn, the total flux decreases due to the lengthening and re-

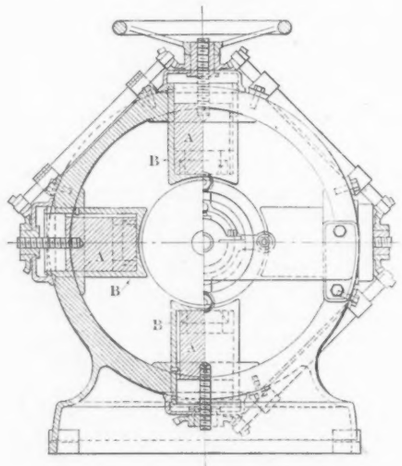



FIG. 3.—STOW VARIABLE SPEED MOTOR.

*U. S. Patents Nos. 666,315 and 672,419, January and April, 1901.

duction of area of the effective air-gap and also the decrease of effective metal in the field cores. The flux is now along the polar edges (in varying degree according to the posi-

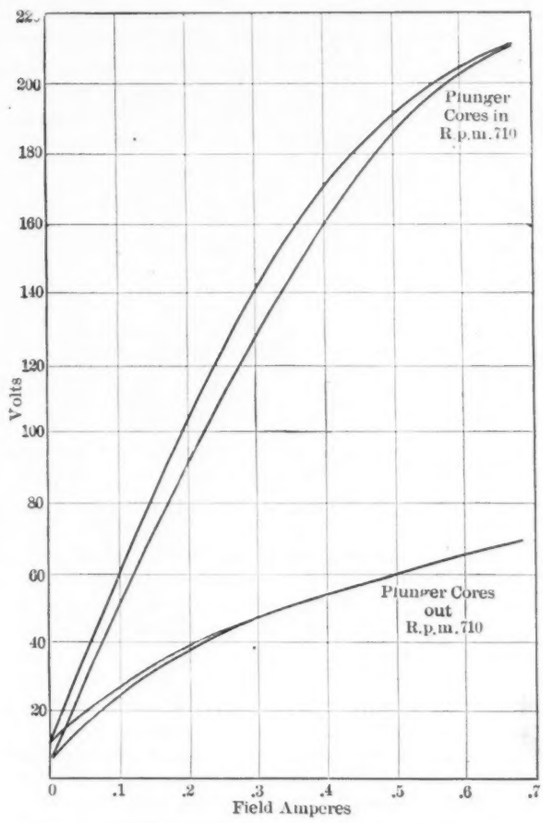



FIG. 4.—MAGNETIZATION CURVES OF 4-HP STOW MOTOR.

tion of the plungers), the field for commutation is maintained strong, and sparking thereby prevented. The concentration of

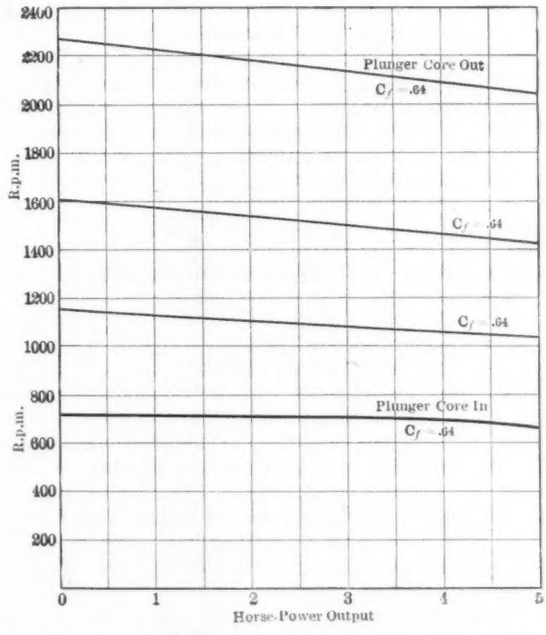



FIG. 5.—SPEED-LOAD CURVES OF 4-HP STOW MOTOR.

flux at the polar edges is well shown by the flux distribution curves (Fig. 7) of this machine. It is also a fact that since metal is removed the effect of armature reaction for a given current is reduced because the reluctance of the path of the armature flux is increased. The data of a 3 to 1 adjustable-speed 4-hp motor of this type are as follows:

Rated pressure, 220 volts.

Armature current at rated load, 16.75 to 17.0 amperes, depending upon the speed.

Field current, .64 ampere.

No-load armature current, 1.3 to 2.2 amperes, depending upon the speed.

Field resistance, 344 ohms.

Speed, 700 r.p.m. min. to 2100 r.p.m. max.

Weight, 800 lb.

Its operation under various loads and speeds is shown in the curves, Figs. 4, 5, 6 and 7, which are, respectively, magnetization, speed-load, efficiency, flux distribution and curves.

*The Lincoln Variable-Speed Motor.*

The variation in reluctance of the magnetic circuit of this design* is obtained both by lengthening the air-gap and by decreasing its effective area. The armature is formed as a truncated cone with corresponding polar surfaces as represented in Fig. 8. The armature is movable in the direction of its axis,

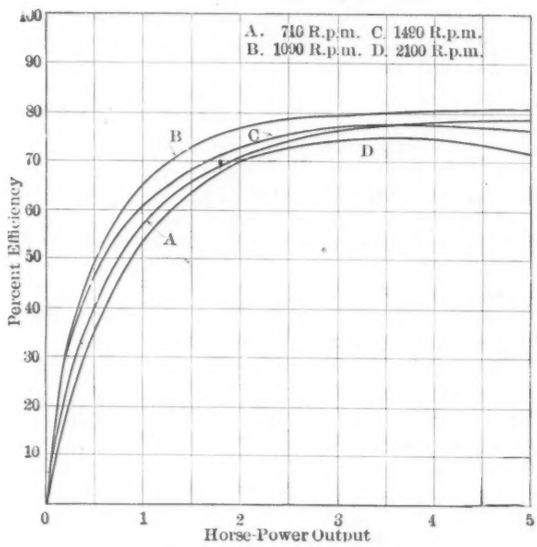



FIG. 6.—EFFICIENCY CURVES OF 4-HP STOW MOTOR.

so that movement one way increases the length of the air-gap, thus decreasing the flux and raising the motor speed.

The characteristic working curve of a machine of 10 horse-power and 5 to 1 speed range are given in Figs. 9 and 10, being those of speed-load and efficiency at various loads, respectively. The principal objections to this design are the extra space required for the armature and the large force required to move it. The flux distribution curves of the motors are similar to those of ordinary single-speed machines, the distortion at high

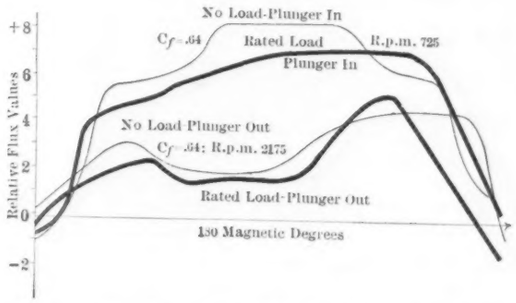



FIG. 7.—FLUX DISTRIBUTION OF 4-HP STOW MOTOR.

speeds being limited on account of the increase of air-gap length. However, to ensure sparkless operation at the high speeds, interpoles in series with the armature are employed.

*U. S. Patent No. 829,974, September, 1906.

*Multi-Voltage Speed Control.*

The remaining methods of direct-current shunt motor speed control differ from those heretofore given in that they depend upon variation of the impressed voltage, and are therefore called *variable* or *multi-voltage* systems in contradistinction to the *single* or *constant voltage* systems already described. In other words, the speed variation is due to changes *external* to instead of *internal* with respect to the motor. The following methods also differ in the fact that they can produce a *constant torque* in

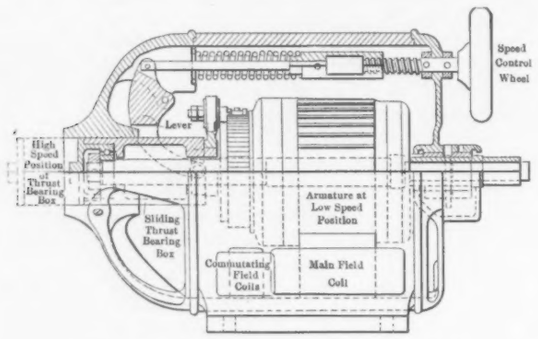



FIG. 8.—LINCOLN VARIABLE SPEED MOTOR.

place of a *constant output* in horse-power. The general classification of these constant torque methods is as follows:

d. Armature rheostat—already described.
e. Multiple voltage (multiple-wire) systems.
f. Motor-dynamo control.
g. Boost and retard system.
h. Teaser system.
i. Double armature methods.
j. Variation of number of poles.

The latter methods, i and j, are constant-torque, but single-voltage supply systems. Nevertheless, in all these types the voltage available for a given armature is varied or an equivalent effect is produced.

In the discussion of the relation between speed and c. e. m. f. it was shown that if other conditions remain constant, the speed varies directly as the c. e. m. f. If we now examine the equation $V = c.e.m.f. + (I_aR_a + D_b)$ it is evident if $I_aR_a$ and $D_b$

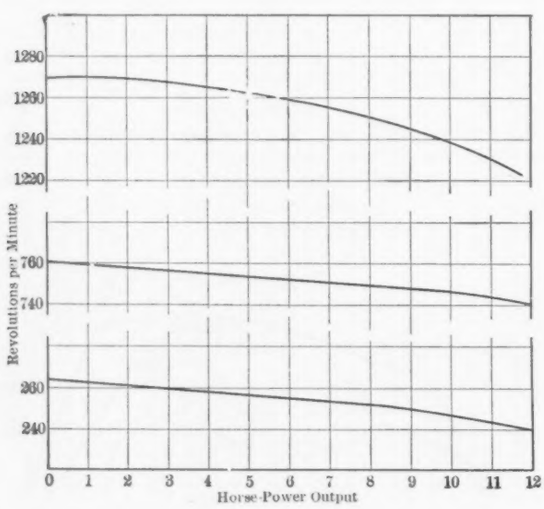



FIG. 9.—SPEED-LOAD CURVES OF 10-HP LINCOLN MOTOR.

are very small with respect to the c. e. m. f. (as is usually the case with an efficient motor) that increase in $V$ will produce, at constant torque, a nearly proportionate increase in c. e. m. f., or a variation of impressed e. m. f. produces a practically proportional change in speed. This is the principle of adjustable or multi-voltage systems.

*Three-Wire Systems.*

The simplest multiple-voltage system is the ordinary three-wire circuit, with 115 volts between either outer and the neutral conductor, and 230 volts between the outer conductors. Thus

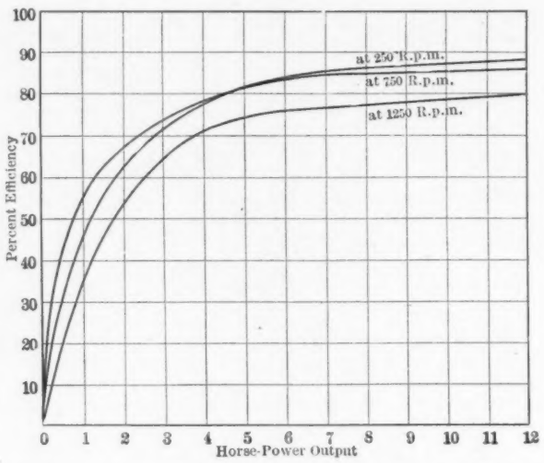



FIG. 10.—EFFICIENCY CURVES OF 10-HP LINCOLN MOTOR.

a 230-volt shunt motor connected so that its field winding is supplied with 230 volts and its armature with 115 volts develops a certain speed, $X$. If the armature terminals are then connected to the 230 volt supply, the speed will be approximately $2X$. The two efficient or running points are one-half and full speed, while those intermediate may be obtained by the introduction of armature rheostat or "field-weakening" control. Assume the 10-hp motor, the data of which were given in the first issue of December, having armature resistance, hot, .28 ohm; brush drop at rated load, 1.4 volts; armature current at rated load, 37 amperes; voltage, 115 and 230.

$IR + D_b = .28 \times 37 + 1.4 = 11.8$ volts. With $V = 115$, the c. e. m. f. is $115 - 11.8 = 103.2$. With $V = 230$, the c. e. m. f. is $230 - 11.8 = 218.2$.

Hence the speed ratio at these voltages is as 103.2 : 218.2, or nearly a 1 to 2 speed change. The objection to this method is that while three wires are necessary, only two running speeds are obtained. An additional speed could be secured from an unsymmetrical three-wire system, *i. e.*, one in which one of the sides has a voltage of $x$ and the other side a voltage of $2x$; but even then only three running speeds corresponding to $x:2x:3x$ could be obtained with three wires. To obtain a much greater range with only one-third larger number of wires, the four-wire systems were developed, and these will be considered in the next article.

## The Choice of Transformers for Central Stations.

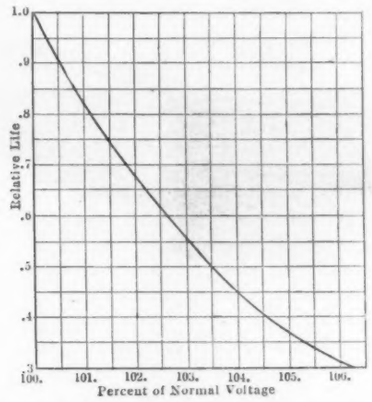
By L. A. Starrett.

During the last few years, the central-station manager has chosen his transformers according to the arguments that have been put forth by the manufacturer's representatives, and of late these arguments have been invariably along the line of low-core loss and high all-day efficiency, irrespective of other valuable points that have been entirely overlooked in the mad rush toward that end. It must be admitted that a low-core loss is desirable, but only when the copper loss has been determined for that particular core loss; and it is the intention of this article to show in plain dollars and cents that the stand taken by three-fourths of the central stations is entirely wrong.

Since the average central-station load is made up largely of incandescent lamps, a transformer with the best possible regulation should be used and this transformer is *not* the one with the high all-day efficiency. The arguments in favor of the transformer with a low-core loss were along the line of lower

operating cost because of the reduced core losses, which in some cases amounted to hundreds of dollars annually.

Since for high all-day efficiency low-core loss is absolutely necessary, the copper loss must be relatively high. Take for




VARIATION OF LIFE WITH CHANGE IN VOLTAGE.

example a 10-kw high-efficiency type. The core loss will be approximately 100 watts and the copper loss 150 watts. The low-efficiency type will have a core loss of about 125 watts and a copper loss of 130 watts. The full-load efficiency of the first transformer will be $\frac{10,000}{10,250}$ or about 97.56 per cent, and of the second, $\frac{10,000}{10,255}$ or about 97.51 per cent. Estimating 4 hours full load and 20 hours no-load the all-day efficiency is 93.02 per cent for the former and 91.91 per cent for the latter type—apparently a very favorable showing for the high-efficiency type.

As the copper loss of the second transformer is less than that of the first, the per cent regulation will be less, since the regulation is merely the ohmic drop across the winding; and the regulation will be proportional to the copper loss, neglecting a slight difference due to the different number of turns and the length of mean turn. In the present case, the regulation of the high-efficiency type will be approximately 1.60 per cent, and for the low-efficiency type 1.50 per cent, and this means increased length of life for the lamps.

For purpose of illustration assume that the central station in question is operating 100 10-kw transformers and is able to produce energy for 1 cent per kw-hour. The cost of supplying the increased core loss for one year will be

$$\frac{365 \times 24 \times 100 \times (125 - 100)}{1000} \times 1$$

or $219.00. In the past this item has been the only one that has been considered, and it should be offset by the saving due to better regulation and the decreased cost of the transformer and the corresponding saving on the investment.

If the full-load e.m.f. of the transformers is 110 volts, the no-load e.m.f. of the first transformer will be 111.76 volts, and of the second, 111.65 volts. If 112-volt lamps are used to avoid burn-outs when the voltage is high with only a small number of lamps in use, the consumer is getting only about 14 candlepower when all the lamps are in service. If the central station supplies 110 or 111-volt lamps, the question resolves itself into more renewals, but satisfied consumers. If the central station is supplying 110-volt lamps and is renewing on the basis of 600 hours at 100 per cent of normal voltage, the first transformer would cause the smaller number of lamps to operate at 101.6 per cent of their normal voltage, and they would have to be renewed at the end of about 441 hours. The second transformer would operate the smaller number of lamps at 101.5 per cent of their normal voltage and their life would be about 447 hours.

The 100 10-kw transformers are supplying energy to 20,000 lamps, and if they are renewed at the end of 441 hours, they must be renewed $\frac{365 \times 4}{441}$ or 3.31 times per year; the second transformer gives a useful life of 447 hours and this requires $\frac{365 \times 4}{447}$ or 3.27 renewals, a saving of 800 lamps per year. Estimating the lamps to cost 18 cents each, to cover the testing, renewing, time, labor, etc., there is a saving of $144. The low-efficiency transformer costs less than the high-efficiency type, the saving in first cost being $1,000, and allowing 15 per cent on the investment, there is $150 per year, which added to the $144 from less renewals, making a total annual saving of $294; from this must be taken $219, which is the cost of supplying the increased core loss, showing a net saving of $75. These figures are variable because the total number of lamps saved on renewing might be less than the 800, because not all the lamps would be in use when the voltage was at the higher point.

Assuming the plant to operate only 12 hours per day, the total saving would be more because the cost of the additional energy would be cut in half. Thus it has been shown that the low all-day efficiency is not economical, and that the best service and cheapest operation are gained by buying the transformer with the best regulation. Even the temperature rise is not a vital point, because the transformers operate at full load for only a small part of the time.

## Electrically Operated Switchboards—II.

By S. Q. Hayes.

PANELS, pedestals and control desks having been described in the previous article, circuit-breakers, switches and auxiliary apparatus operated from the panels, etc., will be taken up for consideration. The apparatus may be considered under the following headings: General features of electrical operation; electrically-operated oil circuit-breakers; electrically-operated carbon circuit-breakers; electrically-operated field switches; electrically-operated field rheostats, and auxiliary apparatus. While it will be obviously impossible to go very thoroughly into all of the subjects covered by these headings, it is the intention to touch briefly on the most prominent features.

### GENERAL FEATURES OF ELECTRICAL OPERATION.

The earliest electrical power plants containing a few machines of small output and moderate voltage were easily controlled from switchboards where all of the switches, meters, etc., were placed on panels. As the voltage and output increased it became necessary to utilize more space for the switching devices and to operate them by mechanical means from a central point. When the plant of the Niagara Falls Power Company was installed, the 5000-hp generators required switches of such size that hand operation was impossible and the switches were

FIG. 1.—TWO-POLE CIRCUIT-BREAKER.

worked by compressed air. The plants of the St. Lawrence Construction Company at Massena, N. Y., and the Kingsbridge and Metropolitan stations of the Metropolitan Street Railway System in New York City adopted an electro-pneumatic type of control for the circuit-breakers. Since that time, practically every large station has installed the straight elec-

trical control operating the circuit-breakers, rheostat face plates, etc., by direct-current solenoids or motors.

Most of this apparatus is designed for use on a 125-volt direct-current circuit, although 250, 550 or any other available direct-current voltage can be used. In generating stations the exciter bus is often the source of the direct-current supply, but, where a regulator is employed that causes the voltage of this bus to fluctuate, it is often advisable to install a small storage battery of about 40 ampere-hours rating in order to have a constant, operating voltage. This battery can be charged from one of the exciters, a small motor-generator set, or by using suitable resistances from a trolley or other direct-current circuit.

Where for any reason it is not desired to install a battery and it is necessary to operate the devices from an exciter bus with fluctuating voltage, the solenoids or motors can be specially designed to saturate at the lowest direct-current voltage, so that the increase in voltage will not materially increase the pull of the solenoid or the speed of the motor.

In rotary-converter sub-stations, the circuit-breakers, etc., are often designed for operation from the 550-volt direct-current

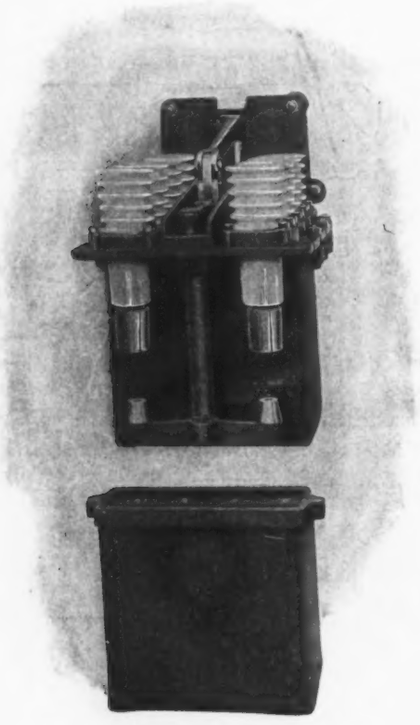


FIG. 2.—FOUR-POLE CIRCUIT-BREAKER.

bus, and if the station has been completely shut down, the first one or two circuit-breakers must be closed by hand. A small battery can often be used to advantage in such a station and may be charged through a resistance from the railway bus. In transformer substations a small battery charged from a 5-kw motor-generator set is nearly always installed.

From time to time, it has been proposed to operate the various devices from alternating-current circuits, and while induction regulators are sometimes operated by small alternating-current motors and special circuit-breakers, such as those for the overhead trolley lines of the New York, New Haven & Hartford Railroad, have been operated from alternating-current solenoids, the direct-current operation is so much cheaper and the additional complication due to its use is so small that operation on alternating-current circuits has made very little headway.

With distant-control apparatus it is necessary for the operator to know whether the apparatus has actually closed or opened or performed the function assigned to it. Some very ingenious methods of signaling have been designed. For a circuit-breaker of any sort, a mechanically-operated switch is usually provided and this switch is thrown from one position to the other by the movement of some part of the mechanism of the main circuit-breaker. A certain amount of lost motion is usually provided so that unless the circuit-breaker goes all of the way in or out

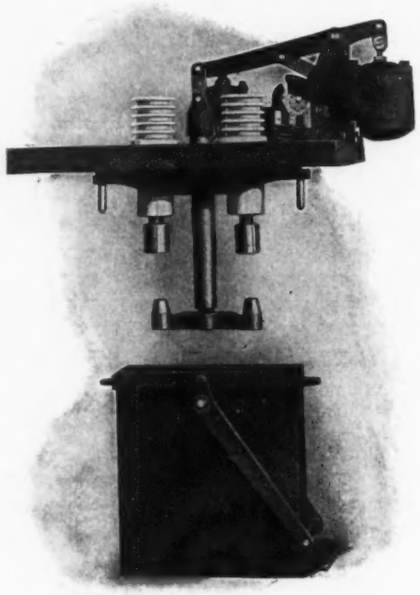


FIG. 3.—SINGLE-POLE OF CIRCUIT-BREAKER.

the position of the signal switch is not altered. From these signal switches, circuits are run back to the switchboard to operate electro-mechanical indicators, signal lamps or some other similar device. These indicators or lamps are often ar-

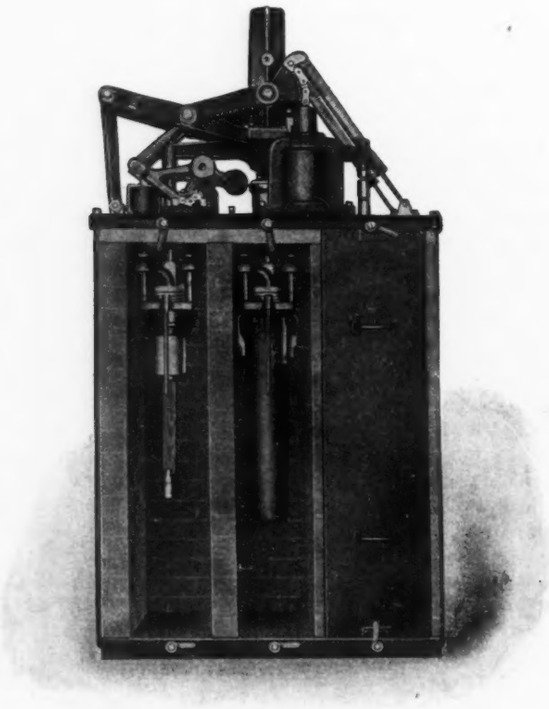


FIG. 4.—OIL CIRCUIT-BREAKER.

ranged to form part of a miniature bus circuit to show the connections that have been made by the circuit-breakers.

In addition to the indicator or the pair of red and green lens signal lamps, that show whether a circuit-breaker is open or closed, a lamp is often supplied that will light up only when a

circuit-breaker has been tripped out automatically, but will not be illuminated if the circuit-breaker has been intentionally tripped by the operator at the switchboard.

Where motor-operated, rheostat face-plates are used, a device is placed on the face-plate that closes the circuit of an indicating lamp on the switchboard when the arm is bridging two contacts. With motor-operated governors, induction regulators, valves, etc., lamps are sometimes provided on the switchboard and so connected that they will light when the motor has reached the limit of its travel in one direction or the other. Similar signaling devices have been designed to take care of all of the conditions arising in power plants of various kinds.

ELECTRICALLY-OPERATED, OIL CIRCUIT-BREAKERS.

The terms "oil switch" and "oil circuit-breaker" as used by various manufacturers are practically synonymous, although some makers draw different distinctions between the two pieces of apparatus. In this article the name "oil circuit-breaker" is used as covering a device for opening the circuit under oil with any condition of overload that may exist at the time. These circuit-breakers may be either automatic or non-automatic and the automatic ones may be provided with relays for overload, underload, reverse power, etc., which may be made instantaneous, adjustable time limit, inverse time limit, etc.

Practically all of the small electrically-operated circuit-breakers employ solenoids, while with the larger circuit-breakers some of the manufacturers use solenoids and others use motors. Each type has advantages claimed for it, and as it is impossible to describe all of the electrically-operated circuit-breakers made by all of the manufacturers in the space of a short article, the practice of one particular manufacturer using solenoid operation throughout for circuit-breakers of 2500 kilowatts rating to those of 200,000 kilowatts will be described.

As the type of circuit-breaker to be employed depends on the amount of energy to be handled, the question of the ultimate breaking capacity of an oil circuit-breaker is one requiring very careful consideration.

With a non-automatic circuit-breaker, such as is usually employed on generator circuits, the chances are very remote that such a piece of apparatus will ever have to open very much more than the overload capacity of the generator or, at the worst, the amount of energy it can develop under short-circuit conditions. With an automatic circuit-breaker, however, which will trip out, due to an overload or short circuit on a feeder, it is possible in some cases to have the entire energy of the station concentrated on that short circuit and opened by the circuit-breaker. The momentary energy at the point of trouble may far exceed that which the machines could continuously develop even under short-circuit conditions, so an automatic circuit-breaker has exceedingly severe conditions to meet. While it is practically impossible to calculate the exact amount of energy which a circuit-breaker might be called upon to open in a given station, it is known from tests and long experience in design that certain circuit-breakers have a reasonable factor of safety when connected to busbars fed from generators with a certain combined kilowatt rating and this has been termed the "ultimate breaking capacity," for which a circuit-breaker can be guaranteed. Under very favorable conditions, the circuit-breakers may be used on busbars having a somewhat greater load, while under extremely adverse conditions of poor oil, etc., it is possible that a circuit-breaker might fail satisfactorily to open the circuit when pushed to the extreme limits; but taken all in all, the ratings are conservative.

Where a double set of busbars is installed or the busbars sectionalized, it is sometimes possible to use smaller circuit-breakers, although the rated output of the station may exceed the "maximum breaking capacity" of the circuit-breakers. Usually water-wheel-driven units have not the same overload capacities as steam-driven units and smaller circuit-breakers might answer in a water-power plant than would be considered safe in a steam plant. For substation work where there will be a certain amount of drop in the feeders from the generating station, smaller circuit-breakers can often be used. It is also occasionally feasible to use a few large circuit-breakers and the rest small ones. As a general rule, however, it is not well to overrate the circuit-breakers without submitting the entire proposition to very careful consideration.

The figures given in the descriptions of the various oil circuit-breakers as the ultimate breaking capacity are those considered safe and conservative by their designers; but it should be stated that few of the circuit-breakers, particularly of the larger sizes, have been tested to the point of break-down as it is practically impossible to obtain the necessary amount of energy for testing purposes even in the largest plants. It should also be noted in connection with the smaller circuit-breakers that seldom can a circuit-breaker be supplied which is good for the maximum current and maximum voltage for which that type is built, and the product of maximum current and maximum voltage will sometimes exceed the ultimate breaking capacity.

Fig. 1 shows a two-pole circuit-breaker that is built in sizes up to 300 amperes at 3300 volts, 200 amperes at 6600 volts with an ultimate breaking capacity of 1500 kilowatts on single-phase, 2500 kilowatts on three-phase, and 3000 kilowatts on two-phase circuits. This circuit-breaker is operated from two solenoids, one of which closes the toggle mechanism and the other of which trips the toggle. A small single-pole double-throw signal switch is mounted on the frame and operated by the moving mechanism. The main contacts are wedge-shaped and renewable arcing tips are provided. All poles of the circuit-breaker are completely submerged in the oil contained in a single, sheet-metal tank lined with wood, having wooden barriers between the poles and provided with filling and draining plugs.

Fig. 2 shows the next larger size of circuit-breaker, which is built in sizes up to 1200 amperes at 3300 volts and 200 amperes at 22,000 volts with an ultimate breaking capacity of 5000 kilowatts on single-phase, 8500 kilowatts on three-phase and 10,000 kilowatts on two-phase circuits. This circuit-breaker, like the one already described, is operated by solenoids that are hidden in the engraving by the mounting frame and the tanks. Through a very simple system of levers the operating solenoids are connected to a cast-iron cross bar, to which are fastened the movable contact arms. To the lower end of a wooden arm is fastened a metal yoke with a conical contact on either end. When the circuit is closed, these contacts engage with two stationary contacts forming one pole of the circuit-breaker. Each stationary contact is supported by a porcelain insulator rigidly secured to the frame. Each pole of the circuit-breaker has an independent tank in which its live metal parts are submerged in oil. These tanks are provided with insulated linings so shaped as to reduce the quantity of oil to a minimum and with the aid of the wooden arm to which the movable contacts are connected, form a barrier between the stationary contacts.

The two circuit-breakers described are self-contained and can be mounted on a wall, framework, or suitable support or may be placed in a masonry structure if desired. The independent cellular construction is not ordinarily required in plants having an output that would permit of their use.

Fig. 3 shows a circuit-breaker built in single-pole units in sizes up to 1200 amperes at 3500 volts and 100 amperes at 33,000 volts and having an ultimate breaking capacity of 6000 kilowatts for two units on a single-phase circuit, 10,400 kilowatts for three units on a three-phase circuit and 12,000 kilowatts for four units on a two-phase circuit. Each pole of the circuit-breaker is intended for mounting in a masonry compartment and two, three, or four-pole units are made by connecting the solenoids of two, three or four poles in the same operating circuit. The mechanism is mounted on a treated soapstone base and a simple system of toggles operated by a powerful solenoid is used for closing the circuit-breaker. A second solenoid is used to upset the toggle and trip the circuit-breaker. A small, single-pole, double-throw switch is mounted on the circuit-breaker and is operated by the motion of the levers in opening or closing the device. This switch controls the signals on the switchboard.

Fig. 4 shows a circuit-breaker built in sizes up to 2000 amperes and voltages up to 33,000 and having an "ultimate break-

ing capacity" beyond the limits of any power plant now installed or contemplated. Each pole of the circuit-breaker is enclosed in a separate, fire-proof, masonry structure and a single powerful mechanism mounted on a cast-iron base that rests on a treated soapstone slab is used with a two, three, or four-pole circuit-breaker. Like all of the other circuit-breakers described, the contacts are so shaped that the tendency is to open rather than to stick, and as the open position is maintained by gravity,

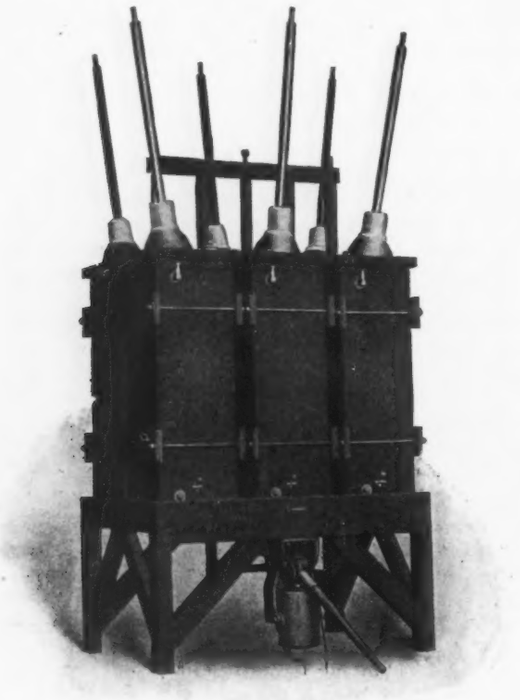


FIG. 5.—HIGH-TENSION CIRCUIT-BREAKER.

failure of the mechanism, breakage of the operating rods or any other unforeseen contingency will cause the circuit-breaker to fall open rather than to fall closed. Each tank of the circuit-breaker is provided with a gage glass for observing the height and condition of the oil. The doors of the circuit-breaker compartments are sometimes provided with panes of clear, wire-glass to permit of ready inspection. The leads of this circuit-breaker leave the top of the tank and pass out through porcelain bushings set in soapstone blocks in the back wall of the structure. These leads usually come out in separate compartments that keep them isolated from each other. The leads to the busbars and to the feeder or generator may all run upward or all downward or some up and some down. The disconnecting switches for isolating the oil circuit-breakers can easily be mounted on the back wall of the circuit-breaker structure, and when so located there is far less chance of an attendant closing these switches while a second attendant is working on the circuit-breaker than if the switches were on one floor and the circuit-breaker on another.

The circuit-breakers shown in Fig. 3 and Fig. 4 are primarily intended for use in power plants where the cellular construction for the busbars, wiring, etc., is needed or desired. In generating stations of about 6000-kw output and upward where the generators feed the busbars and the entire output of the station may be concentrated on a ground or short circuit, it has been found of the utmost importance to isolate the busbars, wiring and connections in fireproof, masonry compartments in such a manner that leads of opposite polarity are separated by soapstone, concrete, brick or similar material. These fireproof walls, barriers, septums, etc., prevent an arc starting in one place and communicating to adjacent conductors. The amount of energy available momentarily at the point of trouble in large stations where the generators are connected to a bus is something enormous and every precaution must be taken to prevent the trouble from spreading. For voltages as high as 13,200 the question of suitable distances and insulation is comparatively simple.

Where the generators are connected to step-up transformers giving voltages from 33,000 to 88,000 or even higher, the question of enclosing the busbars and wiring for the high-tension circuits becomes an entirely different proposition for the following reasons:

First, the violence of an arc and the destructive effect of a short circuit depend on the amount of current available at that point or are inversely proportional to the voltage, for the same amount of power, and while fireproof barriers and cellular construction are required in large plants generating electricity at comparatively low voltage, they are unnecessary for higher voltage plants of the same or even greater rating.

Second, the striking distance from wire to ground has to be greatly reduced over what could be obtained with open wiring in the same space, as the fireproof barriers offer a more or less perfect ground for high-voltage circuits, and the higher the voltage the more perfect the ground.

Third, a more expensive building and more costly structure are needed with enclosed busbars and wiring than for open wiring.

Fourth, inspection and repair are more difficult for busbars, wiring, disconnecting switches, lightning arresters, etc., that are boxed in masonry compartments and only visible and accessible by the removal of doors than if everything was in plain sight. Inspection will be more frequent and thorough and incipient trouble will be noticed far sooner with open wiring than with enclosed wiring, as the station attendant in a few minutes' walk can see everything and does not have to remove many doors and visit two or three floors to examine the condition of the apparatus.

For the foregoing reasons the high-tension, oil circuit-breakers shown in Fig. 5 and Fig. 6 have been made entirely self-contained, requiring no masonry structure and have been designed for use with open, overhead wiring for the busbars and connections. These circuit-breakers are provided with thoroughly grounded metal tanks with oil gages and the operation mechanism is located near the floor where it is readily accessible for adjustment without any danger of coming near the high-

FIG. 6.—HIGH-TENSION THREE-POLE CIRCUIT-BREAKER.

tension, live-metal parts of the circuit-breaker. Provision is usually made for mounting the disconnecting switches in plain sight directly above the circuit-breakers on a suitable support.

Fig. 5 shows a circuit-breaker built in sizes up to 200 amperes and 60,000 volts for an ultimate breaking capacity of 12,000 kilowatts on single-phase and 20,000 kilowatts on three-phase circuits, while a modification of this circuit-breaker is built in

sizes up to 200 amperes and 88,000 volts with ultimate breaking capacities up to 25,000 kilowatts on single-phase and 40,000 kilowatts on three-phase circuits. The hand-closing device used with the electrically-operated circuit-breaker is shown directly over the closing solenoid, and where electrical operation is not desired a hand-closing mechanism with suitable bell cranks, levers, etc., is used and the handle with its trip coils, latches, etc., is placed on the switchboard panels or in some other suitable location.

Fig. 6 shows a three-pole circuit-breaker built for potentials up to 60,000 volts which operates under any conditions of overload or short circuit in a power plant having an output of 200,000 kilowatts. This circuit-breaker is ruggedly constructed throughout. The mechanism is operated by a single, direct-pull, solenoid located at the floor level in front of the circuit-breaker.

Oil circuit-breakers have been designed for operation on voltages of 132,000 and even higher, but as no plants are in operation at these voltages they have not yet been tested under actual working conditions.

## Subway and Cable Records for Electric Light Companies.

BY CHARLES HOLMBERG.

It is desirable that all subway and cable records should be drawn to a scale which should be maintained throughout the entire record system. Diagrams and drawings should be made on a sheet of paper of standard size, say, 24 in. x 36 in., and each sheet should be provided with faint black cross-section lines spaced so that the distance between each line represents 25 ft. on a scale of 100 ft. to the inch. A margin of 1 in. should be left at the bottom of the sheet for the title. The faint black lines serve as a guide in laying out the work, and the paper can be ruled in this manner at any first-class printing establishment. These lines are not shown on the engravings herewith.

Having provided himself with paper of the above description, the draftsman lays off four spaces 2¼ in. high; above these a space 3 in., and above this four spaces 2¼ in. high. The spaces should be bounded with heavy black lines drawn across the sheet. Basing an illustration on New York City service, suppose the owner of a large apartment house at 512 West 146th Street has signed a contract for electric-lighting service, and that the necessary pipes have been laid and the cables pulled in. The record would then be made as follows:

It is essential for the department to have an atlas of New York City in order to accomplish the work set before it. Having located the house number in the atlas, the draftsman makes a scale drawing of the entire block in the 3-in. space. It is the custom in topographical drafting to have all work drawn in such a manner as to indicate north at the upper end of the sheet. This rule simply applies to the streets running east and west. Streets running north and south should be drawn with west at the upper end.

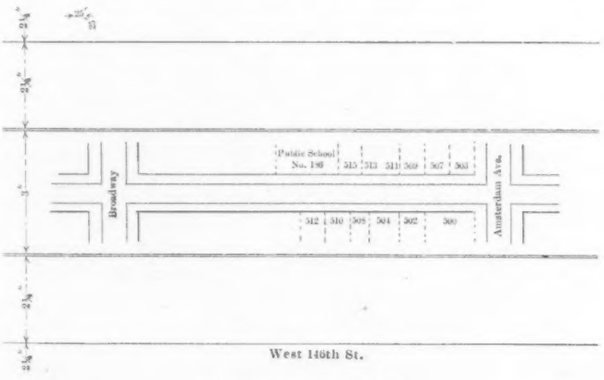



FIG. 1.—SURVEY SHEET.

The survey having been illustrated, as shown in Fig. 1, the subway and cable diagram will be taken up. It may be remarked that the electric-light companies of New York City do not build the conduit or duct system; this is done by a separate company. The electric-light company specifies the location where to build, giving the approximate distance in feet, and the subway company charges the electric company

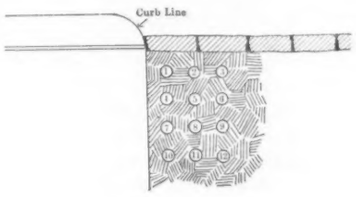



FIG. 2.—DUCTS IN STREET.

rental for the use of subways on the basis of the number of feet built. The smaller connections coming from the subway proper, known as subsidiary connections, are also built by the subway company, but are the property of the electric-light company, which pays for the work done.

The spaces above and below the center space of Fig. 1 are used for ducts that may be assigned to the electric-light company. It is possible to have one or a dozen ducts on a street or avenue between the same points assigned to one electric-light company. If such is the case, the ducts should read away from the curb, and from top to bottom. For example, assuming there are 12 ducts under assignment on the same street, and between the same points, the ducts are named, referring to Fig. 2 as follows: 1, curb duct; 2, second curb duct; 3, third curb duct; 4, curb second bottom; 5, second curb second bottom; 6, third curb second bottom; 7, curb third bottom; 8, second curb, third bottom; 9, third curb, third bottom; 10, curb fourth bottom; 11, second fourth bottom; 12, third curb, fourth bottom. Having the proper location of the ducts, they are now placed in rotation on the extreme left end of the diagram sheet opposite the vacant spaces, as illustrated in Fig. 3. Should the ducts be assigned on the north side of the street, they appear north of the diagram; if the assignment reads south, they appear south of the diagram.

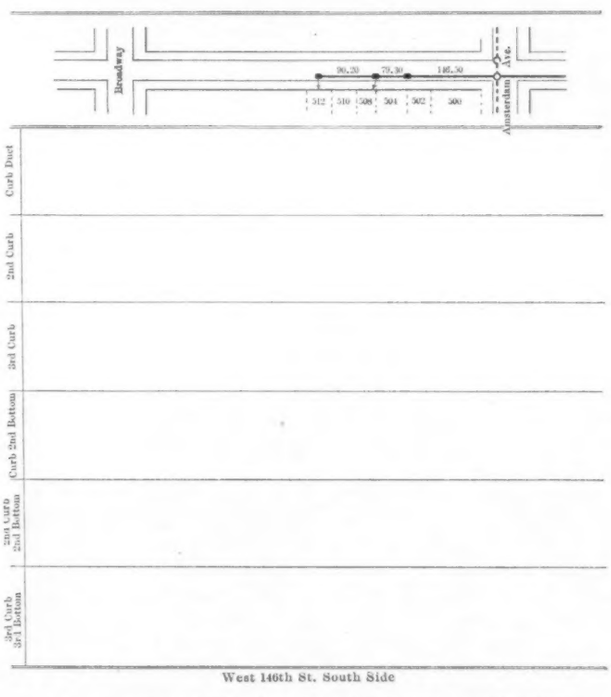



FIG. 3.—DATA SHEET WITH DUCTS LOCATED IN ROTATION.

Before drawing the diagram of the street it is essential to

find out the number of ducts assigned in the system in order that allowance may be made for the additional ducts. The draftsman then places the diagram or the survey drawing at the extreme upper end of the sheet, leaving the lower eight spaces for duct space. In drawing the diagram or survey at the upper end of the sheet, the buildings and subway on both sides of the street, including subsidiary connections, are indicated, but in the duct spaces only cable work appertaining to the north side is shown. The title of this sheet will read "West 146th Street, North Side." The same rule applies to the south side, omitting all buildings and subway on the north side, having simply the skeleton drawing of the north side, as shown in Fig. 3. This sheet will read "West 146th Street, South Side." Having still four more ducts to add and not being able to care for them on the sheets just completed, the drawing is duplicated for either the north or south sides, as the case may be.

Referring to Fig. 2, and assuming the subway has been built and measured, a blue-print is made and sent to the electric-light company showing what has been done as to cutting-in boxes or manholes on the line, tapping subsidiary connections from the mains, etc. Having the blue-print of West 146th Street subway, the desired information is entered in solid black

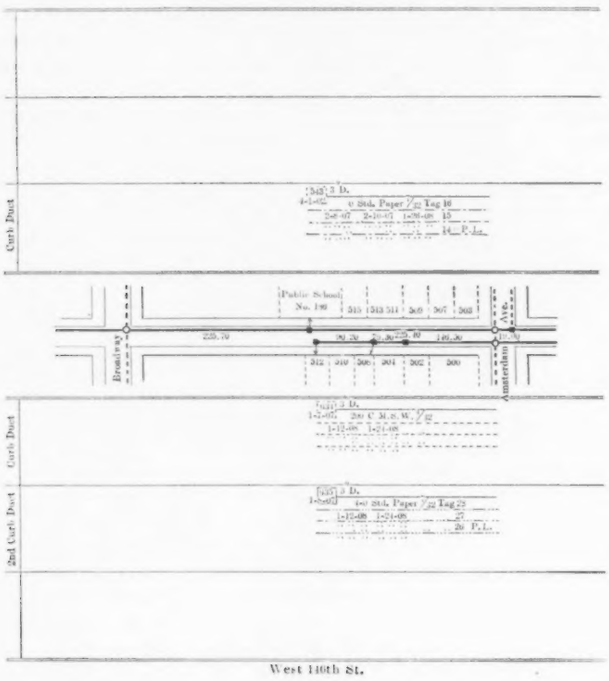



FIG. 4.—COMPLETE RECORD.

in the drawing of Fig. 4, the distances being shown in black figures between manhole and boxes, the same scale is used as in the diagram work. All intersecting subways should be indicated by dotted black lines.

The records, thus far, having been made, the foreman of the electric-light company has the cable pulled through the subway and subsidiary pipes. A great deal depends upon the outside foreman in writing up his weekly reports giving in detail the nature of the cable, the number of feet of cable used, the date of installing same in conduit, also the date when energy passed over it. When the foreman's report is plotted it should show that there had been rodded and drawn in on the south side of West 146th Street, in the curb ducts, from the manhole located at the southwest corner of Amsterdam Avenue and 146th Street, to service box in front of 512 West 146th Street, three 200,000 circ. mil steel and wire 4/32 secondary cables. In the second curb duct should be indicated that three legs of primary cable had been drawn in from the southwest corner of Amsterdam Avenue (225.80 ft.) consisting of three 4-0 standard paper 7/32, Tag 28, 27, 26 cables. The cable tagged 26 is the power leg. The record should also indicate that the above cables, secondaries and primaries, were pulled in on Jan. 19, 1908, and made alive on Jan. 24, 1908. Also on the north side of West 146th Street from manhole northwest corner Amsterdam Avenue to box in front of Public School No. 186, cut dead on Jan. 26, 1908, the three primary cables supplying the above premises, taking for granted the previous report stated that three primary cables were pulled in.

Symbols should be used to indicate the various wiring places, etc. All secondary cable matter should be indicated by a dotted black line; primary cables by a dash and three-dot line; cutting cables dead, a dot and dash line. All one-year assignments should be shown in a dotted black line, placing the assignment number and date when assigned, at the starting point of the duct. The five-year assignments are indicated in solid black. The date of pulling in cables is shown in black figures as indicated in Fig. 5; the second set of figures shows the date when the circuit was turned on. Should the cable be cut dead the date should appear following the second set of figures.

In drawing the cable report in the spaces designated as duct space, care should be taken to follow the run of the duct in which the cable has been pulled in. For instance, from manhole at southwest corner of Amsterdam Avenue and 146th Street to service box in front of No. 512 cables were pulled in. Follow below, using the service box in front of 512 as a base into the duct space opposite the curb duct, starting the assignment at that point and ending at the manhole southwest corner of Amsterdam Avenue and 146th Street. All ducts assigned

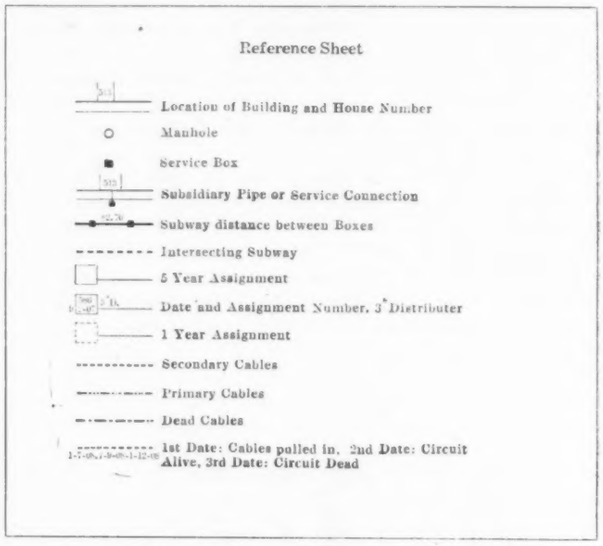



FIG. 5.—SYMBOLS FOR SUBWAY AND CABLE RECORDS.

should read from left to right. Abbreviations in the body of cable work and small lettering are advisable. A reference sheet should be made and placed at the beginning of the diagram sheet. A complete record system is shown in Fig. 4.

The drawing must be plain, direct and all-sufficient. It might be added that to make it so, the draftsman must place himself in touch with the outside foreman, and follow implicitly his reports from time to time. Regarding the smaller connections, known as subsidiary connections, they appear on the diagram sheet, but the details should be shown on a card system.

## Electric Wiring of New and Old Buildings.

By J. E. WeisMandel.

With such great prospects before us in the development of new lamps and electric power, the wiring of new buildings to-day, whether it be a dwelling, apartment house, factory, stable, store or any class of building, is an important factor.

Every electric light and power company should have a "New Building" department, whether the company be a large or small

one, with a man in charge who is capable of consulting architects and builders in the matter of equipping new buildings for electric service. Very few first-class buildings are being erected to-day without being wired throughout for light and power. Not so many years ago builders thought nothing of erecting a mansion, large office or factory building, or elegant apartment house without electric service. But to-day with tungsten and tantalum lamps and electric power that can be used for all purposes it is different.

Electric wiring in a building is one of its best assets and is a great selling factor. The man or woman of to-day who buys or rents a building wants every modern improvement. As electric light and power is within reach of all, it is necessary in most instances to have buildings equipped electrically in order to sell or rent them.

It is almost two years since the building department of the Edison Electric Illuminating Company, of Brooklyn, was organized and the writer placed in charge, and at the beginning it was hard work and pulling up-hill to get builders and architects to wire all modern buildings, but the writer can say that to-day the task is easier.

With all the talk of money stringency, building has been going right along in Brooklyn, and since spring has arrived the Brooklyn building business has increased tremendously, while stores, apartment houses, private dwellings, factories and, in fact, all classes of buildings have been and are being wired for electric service.

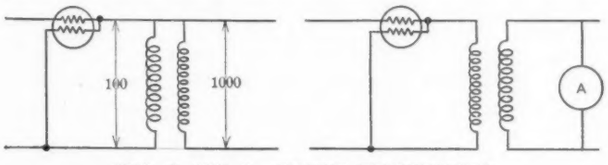
When old buildings are being altered and remodeled it is most important for a representative of the electric company to call at once and consult the architect and builder in reference to wiring. That is the time to induce them to make a modern building out of an old one, by equipping it for electric service. It is safe to say that the majority of old buildings being remodeled are being wired, which proves that electric service is in demand.

The building agent or salesman meets so many different kinds of people in his daily work that in order to be successful he must be able to present his talk in a tactful and logical way, must be courteous and sincere and be ready at all times to give the people he is doing business with any information they desire. When he has accomplished this he gains their good will and friendship, and with these assets his work becomes a pleasure instead of a burden to him.

## Transformer Testing.

By W. M. Hollis.

THE full-load efficiency of a transformer may be determined quite accurately by the following method and without employing full load. The efficiency, of course, is the ratio of the output to the input and if these values are measured at full load several measuring instruments are required in the primary and secondary circuits. If the transformer is a large one, considerable energy is required in making the tests and also measuring instruments of large capacity.




FIGS. 1 AND 2.—TESTING TRANSFORMERS.

With the method outlined below, only a fraction of the full-load energy is required and few instruments.

The primary is considered as the high-potential coil and the secondary as the low-potential coil. The losses may be considered as being made up of the core losses, iron losses, including hysteresis and eddy currents, and the copper losses. The core losses are substantially the same at all loads. With the primary open-circuited, measure the watts supplied to the secondary at its normal voltage, or the open-circuit or core losses. See Fig. 1. Short-circuit the secondary windings and gradually increase the voltage on the primary until full-load secondary current is obtained. The watts supplied to the primary will then equal the full-load copper losses. See Fig. 2. The input at full load is equal to the output at full load plus the sum of the copper losses, hysteresis losses and eddy current losses. The efficiency is equal to the output divided by the input or to the output divided by the sum of the output and the losses.

If a pair of similar transformers is to be tested or a number of similar transformers, a method may be used for testing them in pairs, an additional transformer, which may be smaller than those under tests, being employed during the tests. The method outlined is applicable where transformers of large size are to be tested either with full load or partial load. As was the case with the dynamo and motor tests in a previous article, the losses only are supplied from the mains, so that not only is much energy saved, but large transformers can be tested under full-load conditions with only a comparatively small amount of energy being taken from the mains. In Fig. 3 similar transformers to be tested are represented by *X* and *Y*. Similar ends of the secondaries are connected to the mains, as shown. Of the other pair of similar secondary ends, one is connected to the other main wire through an ammeter, while the other secondary lead is connected to the same main wire through a wattmeter and the secondary of a small transformer. The primary of this small transformer is connected to the main wires through a regulating rheostat *R*. The secondary of the transformer *X*, in whose leads the small transformer is connected, thus has a smaller impressed voltage across it than the secondary of the other transformer under test. The primaries of both transformers are connected so that their e.m.fs. are in opposition, and if the voltages impressed upon the secondaries were the same, no current would flow in these primary windings.

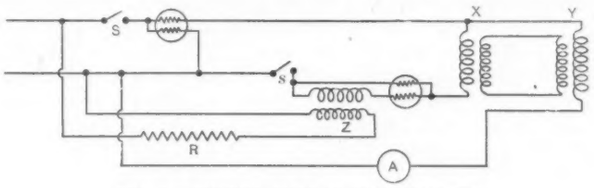



FIG. 3.—TESTING SIMILAR TRANSFORMERS.

By varying the resistance in the primary of the small transformer, its secondary voltage may be varied, and as a consequence the voltage of the branch lead, including the secondary of the transformer *Y*, is also varied. Hence, there are set up circulatory currents in the circuit including the secondaries and in the circuit of the primaries of both transformers *X* and *Y*. The resistance may be varied until the current is such as to give the load at which the losses or efficiency is desired. Switches *s* and *S* are provided, the first in the secondary circuit of the transformer *X* and the other in the lead from the mains. An ammeter is inserted in the secondary circuit of the transformer *Y* and a wattmeter is connected in one of the main leads to measure the power input to the system. Another wattmeter is connected in the secondary circuit of transformer *X*.

Considering the secondaries to have similar ends connected to the mains, and the primaries to be connected in series so as normally to oppose each other, then with equal voltages impressed on the secondaries there will be no current flowing in the primaries, since the induced e.m.fs. will then be equal and opposite at each instant. The effect is, therefore, substantially the same, so far as the effect of voltage of the mains is concerned, as if the secondaries were connected to the line and the primaries were open-circuited.

Considering the pairs of transformers from the secondary side, the small transformer *Z* sends a current through the circuit, including both secondaries, and such current induces in each of the primaries in such direction as to cause circulatory current to flow in the circuit including the primaries, the effect being similar to a secondary excited with the primary short-circuited. Hence only a small voltage suffices to induce full-

load circulatory current in both secondary and primary circuits.

Therefore, the losses only need be supplied from the mains and the small transformer $Z$ to give full-load current values in both transformers. Such losses would ordinarily be less than 10 per cent of the full load of either transformer, and would thus determine the capacity of the small transformer, which must, however, have a secondary capable of carrying the full-load current of the large transformer. The current in the secondary may thus be regulated by varying the resistance $R$ in series with the primary of the small transformer. The power loss equals the sum of the readings of the wattmeters minus the loss in the instruments and leads in the secondary circuit. The latter loss may be found and subtracted, if it is of such a value as to affect the results appreciably, by placing a heavy lead around the secondary transformer coils and measuring the watts when the same current as before is passing, switch $S$ being open and switch $s$ closed. If $V$ is the full-load secondary voltage, $I$ the full-load secondary current, $W$ the watts from the mains, and $W'$ the watts from the small transformer, then $V I$ is the full-load watts on non-inductive load, and by letting $W''$ represent the power loss in leads, instruments, etc., where such loss is so large as to affect the results, the efficiency of both transformers is equal to $V I$ divided by $V I$ plus $W$ plus $W'$ minus $W''$, and the efficiency of either transformer is equal to the square root of this quantity.

A similar method for testing a pair of transformers is shown in Fig. 4. In this case the primaries are connected to the

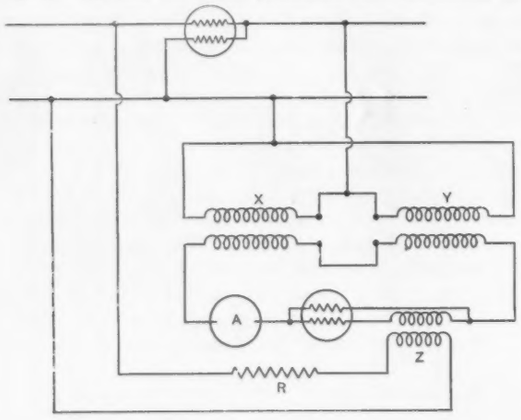



FIG. 4.—TESTING TWO TRANSFORMERS.

mains, while the secondaries are connected in series through the secondary of a small transformer. The wattmeter connected in one of the mains shows the power supplied from the mains, and the wattmeter connected across the small transformer shows the power supplied by that apparatus. The ammeter shows the current in the secondary circuit. The primary of the transformer $Z$ is energized from the mains and is provided with a regulating resistance $R$ for varying the current. The wattmeter across the small transformer then measures approximately the copper loss for the current indicated by the ammeter and that of the leads and instruments. The wattmeter connected in the main circuit measures approximately the iron losses for the two transformers.

As shown in the sketches, the primaries are connected to the mains and the exciting current for the cores circulates through them. The secondaries are connected so that their e.m.fs. are normally in opposition, due to the excitation from the mains through the primaries, and hence no current flows through the secondaries. The only power furnished to the primaries, therefore, is that due to the core losses or open-circuit losses. Now the transformer $Z$ in the secondary circuit sets up an e.m.f. which tends to circulate current in the circuit through the secondaries in series. Such current induces a corresponding circulatory current in the primaries and the connecting lead, the effect being the same, as far as the excitation from the secondary sides is concerned, as though the primaries are short-circuited. Hence a comparatively small voltage is required to cause full-load current to flow in the secondaries and primaries in such including circuits. By measuring the power supplied to the secondary by the transformer $Z$, minus the losses in the instruments and leads, the full-load copper losses corresponding to the value of $I$ are obtained approximately. From these values the efficiency may be calculated.

The wattmeter measurements represent the losses for the two transformers, and half of the sum of the readings represents the loss of each transformer. The efficiency, as before, is represented by the quotient of the output divided by the input, or to the watts output divided by the watts output, plus the losses for each transformer. To make a heat run upon a pair of transformers, the primaries and secondaries may be connected as shown in Fig. 4, though the primaries need not be connected to the mains, and an ammeter should be connected in either the primary or secondary circuits.

## Construction of a Spark Coil.

By F. C. Mason.

Owing to the growing importance of the gas engine, the subject of spark coils for ignition purposes is becoming one of considerable interest. The general principles of induction coils are generally quite well understood, but if an amateur undertook to build a spark coil without a precedent, he would meet with many difficulties. An auto-spark coil resembles in principle a physician's induction coil (or battery, as it is commonly called), but differs in that it has not the brass tube which slides over the core inside the primary coil to regulate the intensity, is provided with a condenser, and the secondary coil contains more wire, thereby creating a higher potential or voltage. The accompanying illustration shows an auto-coil in section and side elevation, end view, top view and component parts in detail.

In order to build a coil such as that shown, procure some No. 18 annealed iron wire and cut off sufficient 5 3/16 lengths to fill a fiber tube of 5/8 inside diameter. File off the ends square and solder a plate of copper on one end not over 1/64 in. thick, the purpose of which is to keep the vibrator from sticking, due to residual magnetism in the core.

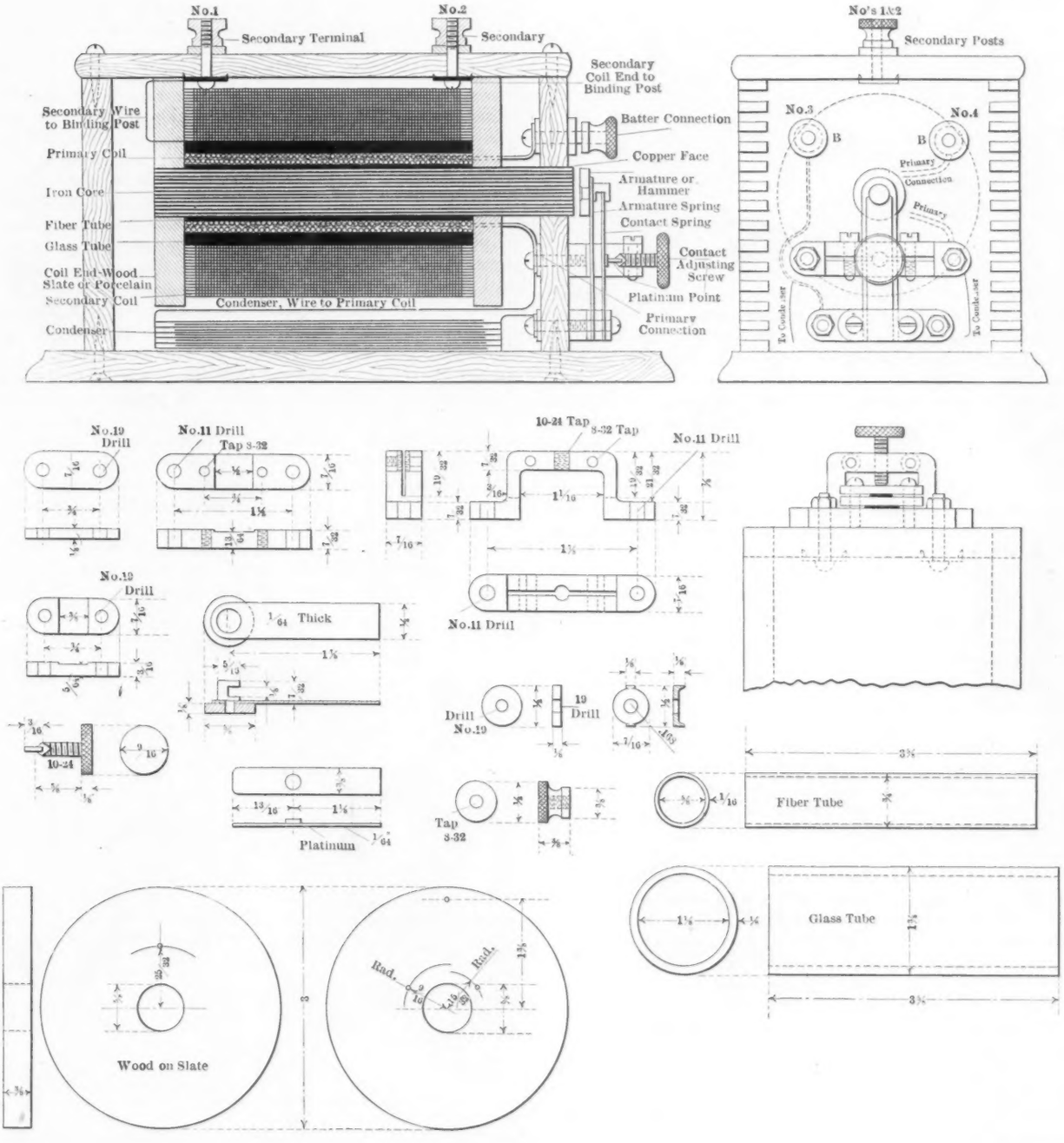
On the fiber sleeve wind two layers of No. 12 double-covered magnet wire and encase the whole in a glass insulating tube of 1 1/8 in. inside diameter. The thickness of the glass tube is not important, but a tube 1/8 in. thick or more is advisable. Since the glass tube insulates the primary from the secondary coil, its mission is important.

The secondary coil is wound with No. 36 silk double-covered magnet wire, which should be of the best quality; for if the insulation is defective the coil will be useless. Before winding have a ladle of melted parafine at hand and a brush. Wind one layer of the wire on the glass tube, starting the winding about 1/4 in. from the end of the tube and discontinuing 1/4 from the opposite; then brush on hot parafine and cover with an envelope of paper. The paper should be fairly thick and of a quality that will absorb hot parafine readily. Return the wire to the paper envelope and wind another layer of wire, starting 1/4 in. from the end and stopping 1/4 in. at the opposite end. Continue this process, layer by layer, coating each time with parafine and a layer of paper, until the coil is of the proper size. The secondary terminals should be on opposite ends, and both primary terminals on the same end. When the coil is completed, soak it in very hot melted parafine for an hour, and then let the coil cool in the parafine until the latter has a mushy consistency, when the coil should be removed and the surplus of parafine wiped off. The coil head may be made of wood, fiber, slate or porcelain; fiber will be entirely suitable.

For the condenser, procure a strip of paper 4 in. wide and about 120 in. long, and cut 40 sheets of tin foil 2 1/2 in. wide by 4 in. long. Fold the paper strip 2 5/8 in. wide and lay in a sheet of foil, leaving the end protruding 3/16 of an inch; fold again and put in another sheet of the foil, allowing the end to protrude on the opposite end of the paper, and continue this pro-

cess until 40 sheets of foil are used up. When finished there will be 20 sheets on each end to connect to. As the tin foil is too delicate for soldering, the connection may be made by forcing a wire against the ends of the foil. The several parts when finished are connected according to the accompanying drawing. Then pour melted parafine in the box until the coil is submerged; allow this to set and then fill the shrinkage. Place the condenser in position, make the condenser connections and then fill the case entirely full with parafine; smooth off and put on the bottom of case and the coil is complete.

If the reader never made a spark coil, this description will give him some ideas as to the repair of such coils. The coil, of course, has to be melted out, and should then be placed in a pan in an oven with the door left open, in order that it shall not heat up too rapidly. If the coil does not work and the vibrator is in good condition, ninety-nine times out of a hundred the secondary terminal is broken, and, of course, this is the most difficult part to get at in most coils.




COMPLETE DETAILS OF AUTO-COIL.

## Automatic Damper Regulators.

BY W. H. WAKEMAN.

In a previous article dealing with the regulation of the draft of steam-boiler furnaces, the writer showed that the time spent in regulating a damper by hand so as to keep the steam pressure in a boiler constant costs enough in a short while to pay for a good automatic regulator that will last many years. There are quite a number of automatic damper regu-

lators on the market and it is the purpose of the present article to explain the principles by which many of these operate.

Fig. 1 illustrates the first damper regulator that the writer has had experience with. It is a simple and inexpensive appliance, but owing to the fact that it requires a variation of from 5 lb. to 10 lb. in the steam pressure to operate it, engineers do not look upon it with favor. However, if more intelligent attention is given to the way in which such a regulator is connected at first and cared for afterward, much better results would be secured from it in every-day service. Connection should be made to the extreme end of the regulator lever as shown, and this lever should move through the whole stroke given to it by its designer, in opening and closing the damper. On the other hand, the damper lever ought to be made as long as the stroke of the regulator will admit, with a damper designed so that the least possible movement of it will either shut off the draft completely or give a free passage for the products of combustion. This is such a comparatively rough class of work that it does not always receive the attention that its importance demands.

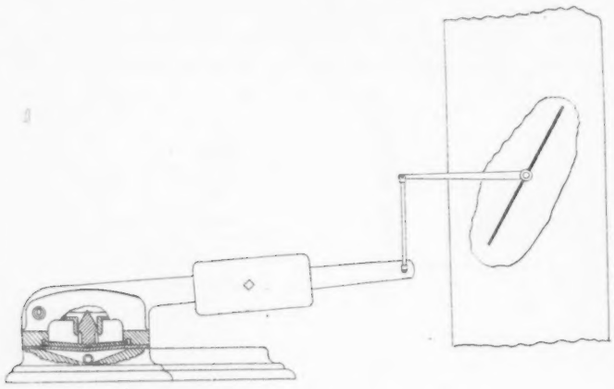


FIG. 1.—AUTOMATIC DAMPER REGULATOR.

To illustrate this point, a certain plant that the writer had charge of several years ago is mentioned. The damper did not work easily, although there was nothing to prevent its operation when sufficient force was applied to the lever. At the first opportunity an investigation was made of the inside of the nearly horizontal smoke pipe. The damper was made of cast-iron and its great weight accounted for the force required to move it. It was circular in form, and its diameter was about 2 in. less than the smoke pipe, hence it could not be shut tight. As the chimney gave a strong draft, this space of about 1 in. wide completely around the damper, allowed much heat to escape and this lowered the steam temperature to about 20 lb. during the night, although there was 60-lb. pressure when the engine was shut down.

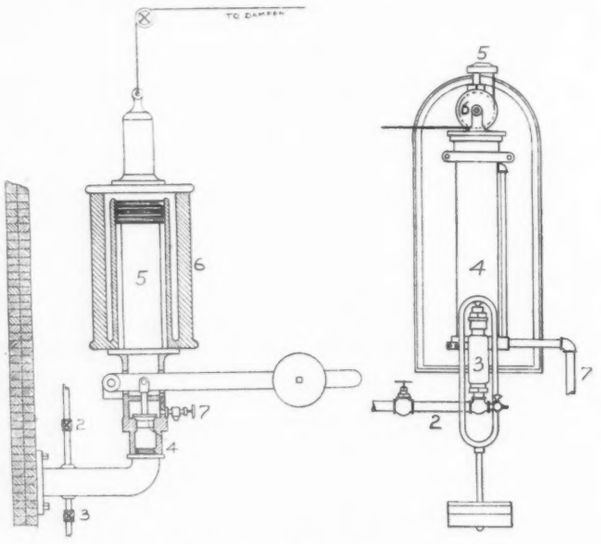
The cast-iron damper was broken into many pieces with a hammer and removed. It was replaced by a larger one made of steel plate about ¼-in. thick, which did not require nearly as much force to move it. The form of it was oblong instead of circular, hence a much less movement of the lever was sufficient to operate it, as a circular damper must be moved through the fourth part of a circle to open or close it.

Where the most economical results from the combustion of fuel are desired, it is necessary to keep the steam pressure steady, but if a so-called regulator is in use that is set to close at 90 lb. and will not open until it has fallen to 75 lb., there is not much satisfaction derived from the operation, and something better is demanded.

Fig. 2 is a very sensitive regulator as it will move before an ordinary steam gage indicates much change in the pressure. Steam is admitted by the valve 2, and 3 is left open enough to allow water to escape to the ash-pit. Pressure acts on 4, which is similar to an ordinary safety valve, hence when it opens steam passes to the chamber 5 and acting on the upper internal surface of the heavy sliding weight or casing 6 throws it quickly upward and closes the damper, or allows it to close as the small wire cable can only draw it open, while a weight that is not shown closes it when the regulator rises. When the pressure falls less than 1 lb. the valve 4 closes and the steam trapped above it begins to escape through the small drip valve 7, which is always open for this purpose. This allows 6 to fall quickly and thus open the damper.

This regulator operates so quickly and is so sensitive to changes in the steam pressure that the damper to which it is attached is either closed tightly or else is wide open, therefore as soon as the fire is deadened by the closed damper enough to make the pressure begin to fall the full draft is put on again and the rapid combustion of coal begins promptly. Engineers who favor the idea of burning coal as quickly as possible in order to obtain the greatest amount of heat from it adopt this style of regulator for obvious reasons. As it opens quickly the full force of the draft is realized at once, and this draws much of the light soot and ashes entirely through the tubes of a boiler, leaving only the heavier parts to remain and choke the draft. This regulator can be connected rigidly to the damper lever by means of an iron rod, provided this kind is preferred, if the regulator is located near the damper. Steam pressure moves the damper in one direction in this case, while the heavy sliding weight 6 carries it in the opposite direction. It is generally considered best to locate the regulator in a desirable place, usually in the engine room, and use a small wire cable running over pulleys to form the connection.

As a general rule, damper regulators are designed so that an upward movement of some part closes the damper, but that shown by Fig. 4 acts in the opposite direction. With a low pressure on the boiler, the damper is held open by the weight shown, and the regulator piston is in its highest position also by action of the weight. Steam enters at 2 and is exhausted through 3, when its work is done. As soon as the highest desired boiler pressure is secured, it is sufficient to force the piston in the cylinder 4 downward, raising the weight and closing the damper. When it falls about 1 lb. the weight predominates and the draft is put on again. The above explanation shows that full boiler pressure is utilized to close the damper, which gives a large excess of force over what is required to overbalance the weight. There are no weights directly on this regulator, but provision is made for varying the pressure at which the damper will be closed, by means of a hand-wheel at the top.




FIGS. 2 AND 3.—DAMPER REGULATORS.

Fig. 3 illustrates another regulator in which steam is used directly. As long as the boiler pressure is below the desired limit, the damper is held open by action of a weighted lever in the usual way, and the regulator remains in the position shown. Suppose that it is desired to carry 90 lb. pressure. As soon as

this point is reached steam entering the pipe 2 opens the pilot valve 3 against the weights, which appear below it, and admits pressure to the main cylinder 4. Here it forces a piston upward carrying with it the piston rod and connection 5 to one end of which is attached a small wire cable that passes under the pulley 6. This drawing action on the wire cable pulls the damper shut and holds it there until the boiler pressure falls 1 lb. The lower weights now close the pilot valve 3, shutting steam off from 4 and exhausting it through 7 to the ash pit. This allows 5 to move downward, assisted by the weighted lever on the damper, until the full force of draft is available for the fire. If a rigid connection is desired and it is practicable to locate the regulator near the smoke pipe or stack, the lower end of a connecting rod can be pivoted at 5 and then carried upward to the damper lever. However, there is no special advantage gained by this plan.

Every regulator that is designed to be operated by steam ought to be connected so that only dry steam will be taken from the boiler, and the steam pipe should be well covered with a first-class non-conductor of heat, in order to prevent condensation, for if this is excessive on account of a long pipe in an exposed location, it will probably interfere with the sensitiveness of the machine. Furthermore, there may be more or less investigation to determine the amount of steam that it uses per hour, and this can easily be determined by letting the exhaust steam go into a pail of cold water. By weighing this water before and after the test, it is possible to determine the exact weight of steam used. This should include only what is actually necessary to operate the regulator, and not the weight uselessly condensed in the steam pipe. The pipe should drip back to the boiler until a point above the regulator is reached, when it can be brought straight down to the place designed to receive it.

Fig. 5 is similar to the regulator shown in Fig. 3, except that a lever is employed at the top instead of a direct connection. As boiler pressure is available for the operation of this regulator, there is plenty of force to move the main piston upward even if the leverage is against it, and the weight closes the damper quicker on acocunt of this leverage, which is in favor of the closing movement. Live steam is admitted through the pipe 2, condensation is drawn off through 3, and allowed to escape through the exhaust pipe 4.

A small sight-feed lubricator should be put on the steam pipe of every regulator that is operated directly by steam pressure in order that a few drops of first-class cylinder oil may be supplied to the piston once or twice a week. In this case there is one shown, but they are seldom found in practice.

The regulator shown by Fig. 6 uses the direct pressure of steam without any complication in the valve mechanism.

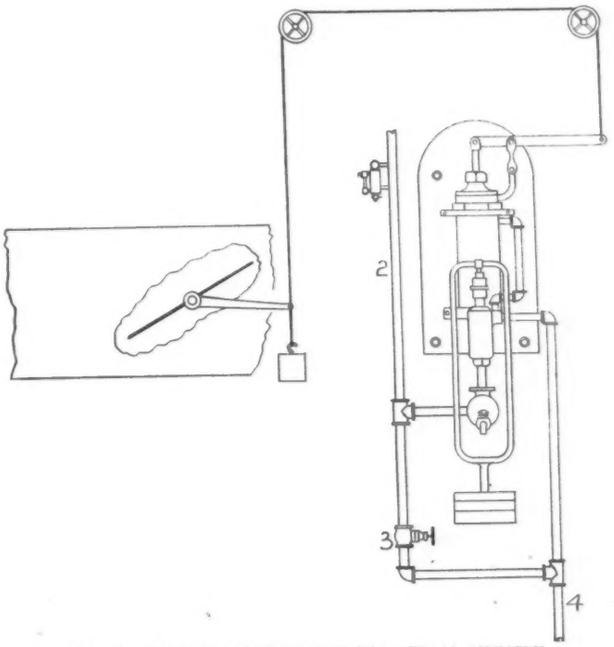
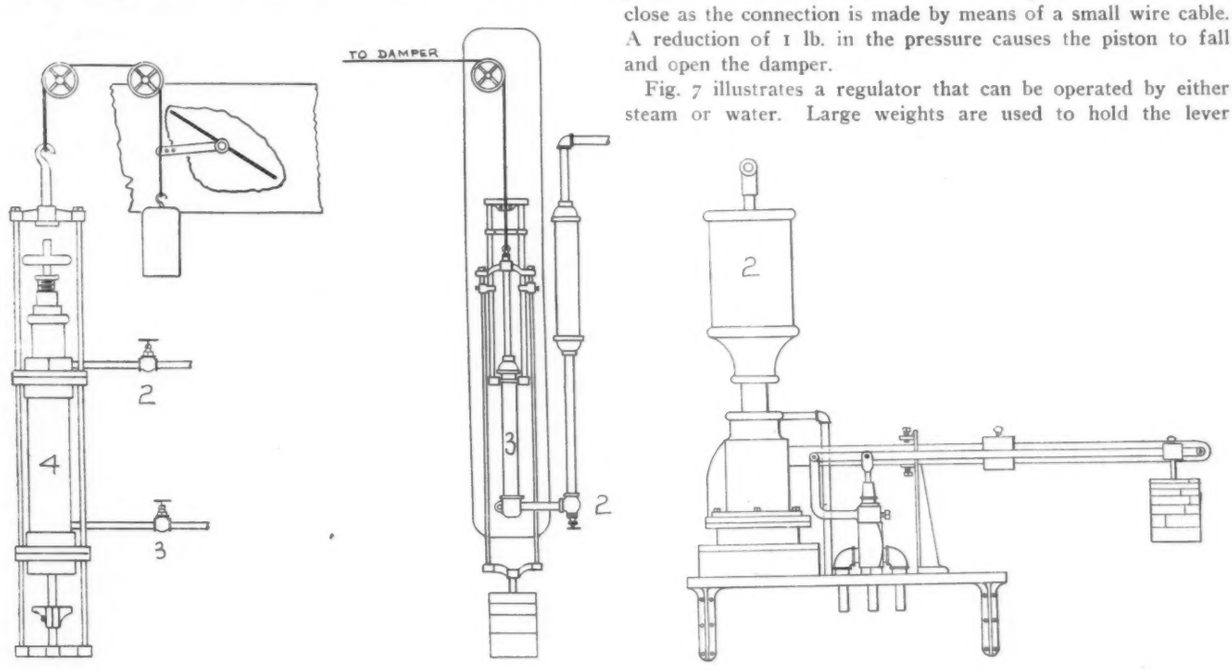



FIG. 5.—DAMPER REGULATOR USING STEAM DIRECTLY.

Steam is admitted through the inverted angle valve 2 into the cylinder 3, where it forces a piston upward when the maximum pressure is secured, and closes the damper, or allows it to close as the connection is made by means of a small wire cable. A reduction of 1 lb. in the pressure causes the piston to fall and open the damper.

Fig. 7 illustrates a regulator that can be operated by either steam or water. Large weights are used to hold the lever down, and the damper open as long as the pressure is below the limit, and more or less weight is used here according to the pressure it is desired to carry. Suppose that with the small weight in towards 2 as far as it will go, and the outer weight on as shown, the damper closes at 98 lb. when 100 are wanted. The small weight may be moved outward until two more pounds are secured without using another weight.

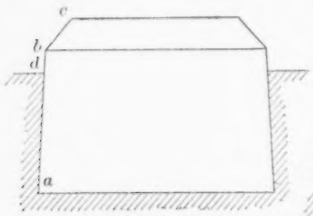



FIGS. 4, 6 AND 7.—AUTOMATIC DAMPER REGULATORS.

# LETTERS ON PRACTICAL SUBJECTS

ENGINE AND GENERATOR FOUNDATIONS.

Will you add your influence toward correcting a practice followed by some designing engineers which proves an unmitigated nuisance to the erecting engineer and a source of useless expense to the owner? The point directly referred to is the practice of laying concrete foundations with taper sides. Examples of this form of engine, generator and motor foundations are



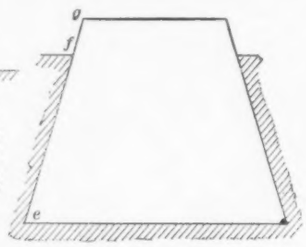



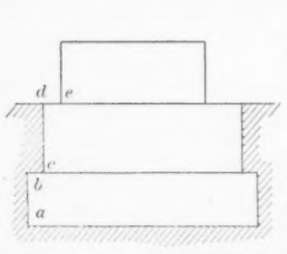

FIG. 1.—BEVEL SIDE FOUNDATION AND TOP TAPER. FIG. 2.—SLOPE SIDE FOUNDATION.

shown by Fig. 1 and Fig. 2, and the same foundations, redesigned to conform to the principles of simple and economical construction, are shown by Fig. 3 and Fig. 4, respectively.

In the tapering foundation, the expense and trouble involved in making the form wherein the concrete is to be poured, much more than offsets the saving in material possible thereby. The usual function of a foundation is to afford such an area of surface to support the load to be carried that the particular soil met with can carry the load placed upon it. If a given soil will not carry more than 1500 lb. to the square foot, and there are 10 tons of dead weight to be carried upon a space of 12 in. square, it stands to reason that a foundation must be put in with a footing so large that the pressure between foundation and soil will not exceed the load permitted, in addition to the weight of the foundation.

A load of 10 tons, upon soil good for 1500 lb. to the square foot, means that $10 \times 2000 + 1500 = 13.7$, or about 14 sq. ft. of footing will be necessary under the load. This means a footing about 3 ft. 8 in. square, and as the bottom only needs to be of the stated size, it is the usual custom of the draftsman to draw straight lines from the desired width at the bottom to the 12-in. requirement at the top of the foundation. This means that the foundation tapers 26 in. from top to bottom, or 13 in. on each side. The depth of any foundation is due entirely to the requirements of the location, as far as the level of the bottom is concerned, and to the desired height of the machine for the level of the top of the concrete work.

The kind of soil and its profile, together with frost-line requirements, must determine the distance between top of foundation and the footing, but that requirement makes no difference with my plea for foundations with straight sides. Consider how much cheaper and easier it is to build and to fill and ram a form built according to Fig. 3 or Fig. 4 than a form built like Fig. 1 or Fig. 2. Fig. 1 must have a form with continuous smooth and tight sheathing from top to bottom, and after that is completed, from *a* to the height of *c*, a facier, *b-c*, must be mitered inside the outer form, and this facier must be made so strong and so well supported that it can withstand the rough usage of handling and tamping several tons of concrete, without being knocked to pieces.



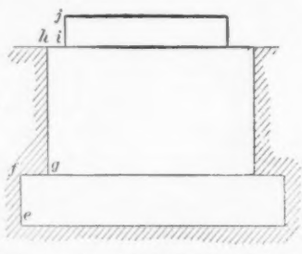




FIG. 3.—FIG. 1 REDESIGNED. FIG. 4.—FIG. 2 PROPERLY LAID OUT.

Compare the cost of a form for Fig. 1 with that of the very simple forms required by Fig. 3. The width, depth and requirements of the two foundations are precisely the same, but the form shown by Fig. 3 requires much less lumber and labor, only three plain, shallow boxes, without top or bottom, being required. Unless too large, these boxes may be made elsewhere and brought ready for use to the site of the foundation and laid down ready for filling. Good, strong corners, a few wires from each side to the opposite side, and the form is ready. Each successive box-form may be laid on top of the filling in the preceding box, and perhaps connected thereto by means of a few strips of wood at the middle of the sides or at the corners—just enough to keep the form in place until the first layer of concrete has been placed—and it is ready for use and half filled before the form shown in Fig. 1 could have been half constructed.

The beveled top shown in Fig. 1 seems to have been placed there merely to give occupation to the draftsman, and there seems no reason why the shape shown by Fig. 2 should not have been used instead of that shown in Fig. 1, had the draftsman stopped to think at all of the shape given the concrete work.

In Fig. 3 the same dimensions are worked to as in Fig. 1. The footing at *a* is the same size in both illustrations, the ground line *d* is located at the same place, and the only appreciable difference between the two foundations are the off-sets at *f*, *c* and at *d*, *e*. There is, however, one other difference, and one which will delight the owner: much less concrete is required by the form shown in Fig. 3 than is required by the form shown in Fig. 2.

The point to be looked after closely, in foundations of this character, is that the width of each successive layer or level is not so great that the pressure cannot be transmitted from the course above without breaking off the extensions of the next lower course. That is, in Fig. 4, the projecting course *f*, *g* shall not be so great, compared with the depth of *e*, *f*, that the piece *f*, *g* will be broken off. In other words, the angle made by *e*, *g* must be little enough so that the carrying power of the footing *e*, *f* is safely transmitted to the next course, *g*, *h*. The angle *e*, *g* shall not be greater than is called for by good engineering practice, and in changing the design of foundations and footings, in the field, to conform to the common-sense method as depicted by Figs. 3 and 4 (and the change is made oftener than the draftsman who made the drawings is aware) care should be taken to keep within safe limits in making projections of square blocks instead of the beveled continuous sides as shown by Figs. 1 and 2.

The writer, in making such changes, never permits the angle made by the *e*, *f* to be greater than 45 deg., and in nearly every instance the angle is kept at about 60 deg. Either angle is safe, but the 60-deg. angle has a better factor of safety and should be used whenever possible.

New York City. James Francis.

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THERMIT FOR STEAM-PIPE REPAIRS.

Will some of your readers who are acquainted with thermit advise me if that substance can be used for making emergency repairs to large steam pipes, fittings or heaters, etc.? Could a broken casting be mended with thermit in a few hours in such a manner as to enable steam machinery to be used until permanent repairs could be made? Or, are repairs made with that material of a permanent nature? As understood by the writer, thermit is a mixture of substances which permits combustion to proceed in the mixture under certain conditions, the heat of combustion thus obtained being sufficient to melt iron and some other substances when mixed with or in contact with the thermit, the oxygen necessary for combustion being supplied by the materials composing thermit ingredients. If thermit is

available for mending castings, it would be invaluable when frost has knocked the bottom out of a power pump, or cracked an elbow. It would prove very satisfying to be able to mend a split place in one side of a water pipe; and to the marine engineer, thermit would be a godsend for everything, from patching a hole in a Scotch boiler to repairing a broken wheel-shaft. They can mend rubber posts with thermit without taking the part from its place in the vessel. As that is possible, why cannot the substance be used for emergency repairs in the engine room and in the boiler house? Why is not the electric worker equipped with thermit as a part of his regular working material?

BOSTON, MASS. JOHN JACKSON.

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### DYNAMOMETER DYNAMO BELTS.

A central station engineer recently said to the writer: "I wish someone would invent a dynamometer belt which could be put on any pair of pulleys and indicate the exact amount of power which is being transmitted." After considerable study, the writer found that by the proper observance of the conditions under which a belt is working at any given time, the power being transmitted can be calculated with a considerable degree of accuracy. In Fig. 1, a belt is shown under supposedly working conditions, the pulleys being located on shafts level with each other. It will be observed that when the belt is working, the upper, or idle fold sags 6 in. from a line drawn across the top of each pulley. The lower, or working fold of the belt sags 3 in. The belt is of double leather, 10 in. wide, and weighs 2 lb. to the square foot. It is possible to determine the power of this belt from the simple factors of suspended belt length, weight and the amount of drop. The curve formed by any belt suspended between two fixed points is known as the catenary, and its functions are as shown by Fig. 2, which represents a string or a chain hung between two nails. Ordinarily, the equations for the catenary are very hard

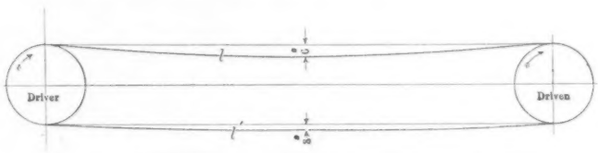



FIG. 1.—WORKING AND STANDING STRESS IN A BELT.

to manage because of the angle $v$, which must be measured with considerable accuracy, and until that angle is known little can be done toward making the necessary calculations. But by the aid of a table given in Nystrom's "Elements of Mechanics," the catenary curve as manifest in a suspended belt may be easily and quickly handled. For convenience, the table in question is reproduced in full herewith:

TABLE FOR THE CATENARY CURVE.

| Angle | Abscissa | Ordinate | Curve | $\frac{y}{x}$ | $\frac{l}{y}$ |
|---|---|---|---|---|---|
| $v$ | $x$ | $y$ | $l$ | | |
| 30 | 1.00000 | 1.31690 | 1.73210 | 1.3169 | 1.3153 |
| 40 | 0.55573 | 1.01068 | 1.19175 | 1.8186 | 1.1792 |
| 45 | 0.41421 | 0.88137 | 1.00000 | 2.1278 | 1.1346 |
| 50 | 0.30540 | 0.76291 | 0.83910 | 2.4981 | 1.1000 |
| 54 | 0.22078 | 0.65284 | 0.70021 | 2.9570 | 1.0725 |
| 60 | 0.15470 | 0.54930 | 0.57735 | 3.5507 | 1.0511 |
| 62 | 0.13257 | 0.50940 | 0.53171 | 3.8425 | 1.0438 |
| 64 | 0.11260 | 0.47021 | 0.48773 | 4.1759 | 1.0372 |
| 66 | 0.09484 | 0.43169 | 0.44523 | 4.5518 | 1.0314 |
| 68 | 0.07853 | 0.39376 | 0.40403 | 5.0141 | 1.0261 |
| 70 | 0.06418 | 0.35637 | 0.36397 | 5.5527 | 1.0213 |
| 71 | 0.05762 | 0.33786 | 0.34433 | 5.8636 | 1.0192 |
| 72 | 0.05146 | 0.31946 | 0.32492 | 6.2079 | 1.0171 |
| 73 | 0.04569 | 0.30116 | 0.30573 | 6.5914 | 1.0152 |
| 74 | 0.04030 | 0.28296 | 0.28675 | 7.0213 | 1.0134 |
| 75 | 0.03528 | 0.26484 | 0.26795 | 7.5068 | 1.0117 |
| 76 | 0.03061 | 0.24681 | 0.24933 | 8.0631 | 1.0102 |
| 77 | 0.02630 | 0.22887 | 0.23087 | 8.7023 | 1.0088 |
| 78 | 0.02234 | 0.21099 | 0.21256 | 9.4445 | 1.0073 |
| 79 | 0.01872 | 0.19318 | 0.19438 | 10.820 | 1.0062 |
| 80 | 0.01543 | 0.17542 | 0.17633 | 11.372 | 1.0052 |
| 81 | 0.01247 | 0.15773 | 0.15838 | 12.654 | 1.0041 |
| 82 | 0.00983 | 0.14008 | 0.14054 | 14.254 | 1.0033 |
| 83 | 0.00751 | 0.12248 | 0.12278 | 16.309 | 1.0025 |
| 84 | 0.00551 | 0.10491 | 0.10510 | 19.046 | 1.0018 |
| 85 | 0.00382 | 0.08738 | 0.08749 | 22.874 | 1.0013 |
| 86 | 0.00244 | 0.06987 | 0.06993 | 28.613 | 1.0008 |
| 87 | 0.00137 | 0.05238 | 0.05241 | 38.171 | 1.0005 |
| 88 | 0.00061 | 0.03491 | 0.03492 | 57.279 | 1.0002 |
| 89 | 0.00015 | 0.01745 | 0.01745 | 114.586 | 1.0000 |

Referring to Fig. 2, it will be seen that there is a half-length of span, $y$, and a depth of curve, $x$, both of which are given in Fig. 1, where $y$ is 150 ft., the half distance between the pulleys, and $x$ is 6 in. for the idle, and 3 in. for the working fold of the belt. There is a column in the table which gives the values of $y \div x$, and for the idle fold of the belt $y \div x = 150 \div 6 = 25$. For the working fold, $y \div x = 150 \div 3 = 50$.

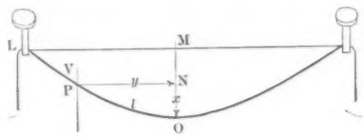



FIG. 2.—CATENARY CURVE.

Looking up these quantities in the table, it is found that in the column $y \div x$, by interpolation, $25 = 85.5$ deg. and $50 = 87.8$ deg., nearly. The above calculations neglect the slight shortening and lengthening of the distances $l$, and $l^1$, Fig. 1, caused by the belt hanging a very few degrees on either side of the vertical center line of the pulleys. There is also neglected the slight variation in the length of the belt folds due to the sag of the belt between the pulleys. In case of the upper, or idle fold, the two neglected quantities will nearly balance each other. In the working fold, they are very small, hence both are neglected and the shaft distance is taken for the length $l$ of the catenary curve, Fig. 2. Or, one-half the belt length.

The strain at the supports may be found directly the angle of the angles $v$ and $v^1$ are known, together with the weight $W$ of the 12.5 ft. of double belt, which, taken as $l$ in. wide and 3 oz. to the foot = 18 oz. to the square foot (16 oz. is a minimum weight for single leather belting) making the weight of the 12.5-ft. x $l$-in. strip equal to 2.33 lb., therefore, $W = 2.33$.

Using the formula: $F = (W \sin v) \div (\sin 2v)$, and having

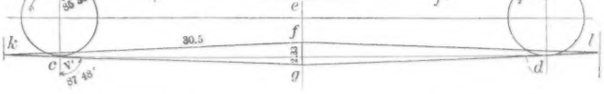



FIG. 3.—GRAPHIC METHOD OF CALCULATING BELT PULLS.

found that: $W = 2.33$; $v = 85.5$; $v^1 = 87.8$; $F$ = strain on the belt at $L$, Fig. 2: sin $v = .99692$; sin $v^1 = .99926$; $\sin 2v = .15643$; sin $2v^1 = .07642$. Then by substitution: $F = 2.33 \times 0.99692 \div 0.15643 = 14.94$ lb.

The pull on the idle fold of the belt is, therefore, 14.94 lb. (slide rule calculations) to the inch of belt width. For the working fold of the belt, the angle $v$, = 87.8, the pull on the belt will be: $F = 2.33 \times 0.99926 \div 0.07642 = 30.5$ lb. The difference between the pull of the working and idle folds of the

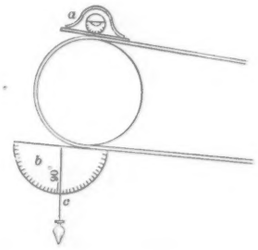



FIG. 4.—MEASURING BELT ANGLES.

belt: $30.5 - 14.94 = 15.56$ lb. to the inch of belt width, and it is at once evident that the belt is not loaded to its full capacity.

The tension of the belt when at rest may now be found, for the sum of the pulls upon both folds of the belt is the same, no matter whether the belt is working or standing still. The sum of the pulls: $30.5 + 14.94 = 45.44$, which, divided by

$2 = 22.72$ lb. for the initial strain in the belt to the inch of width when standing idle. It is evident that this belt is underloaded and can stand being tightened provided there is need of it—so as to do twice as much work.

There is another way of obtaining the load on the dynamometer belt, and that is by the graphic method. Fig. 3 illustrates this method, the pulleys being drawn to scale and placed the actual distance apart and on the same level. It is not necessary to draw the catenary of the belt, the tangents formed by the belt at the points where it reaches and leaves the pulleys, as

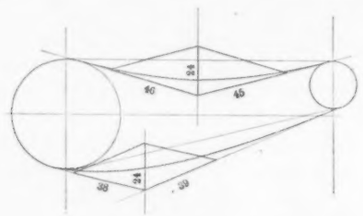


FIG. 5.—PULL OF LOOSE BELT.

shown at *a b c* and *d* sufficing. The lines *a* and *b* intersect at *e*, from which the weight of the belt is laid off vertically, $e\,h = 2.33$, by any convenient scale. It is not necessary that the same scale be used as was employed for laying out the drawing of the pulleys, for any convenient scale will answer.

Having laid off the distance $e\,h = 2.33$, the line *h i* is drawn parallel to *e b* until it intersects line *a e*, at *i*. Then line *h j* is drawn parallel with line *a e*, intersecting at *j*. With the same scale used in laying off *e h*, the lines *h i* and *h j* are measured and found to be 14.94, the belt tension at *a* and at *b*, as was calculated.

In a similar manner tangents *c g* and *d g* are drawn at the angle upon which the working fold leaves and reaches the pulleys. These lines intersect each other at *g*, upon which a perpendicular 2.33 long is erected, as before described, and the lines *f k* and *f l*, drawn from the point *f*, as described for the lines of the idle fold of the belt. It is found that the lines do not come together until past the centers of the pulleys. This makes no difference, the tangents are produced to *k* and *l*, where the lines actually intersect. Measuring the lines *g k* and *g l* shows them to be 30.5 long, and this quantity is the belt pull in pounds to the inch width of belt as found by the calculations, thereby checking the figures obtained in that manner. There are several ways of obtaining the angles of the belt, and two simple ways are shown by Fig. 4. The method shown at *a* calls for the use of one of the little iron levels in which there is a loose disk which carries the bubble vial. The disk is graduated in degrees, and has a movement of 90 deg., so that the tool may be used for indicating horizontals and perpendiculars, and any included angle, by simply turning the loose

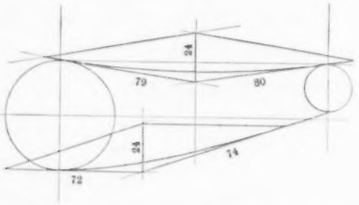


FIG. 6.—EFFECT OF TIGHTENING THE BELT.

disk until its position against the graduated circle indicates the angle desired. It is, then, only necessary to place a strip of wood or metal parallel with the direction of the belt where it leaves the pulley. Once the strip is erected correctly, it is only necessary to take its angle with the little instrument described, and lay that angle down upon the drawing.

Another method, shown at *b*, Fig. 4, makes use of a half-round piece of board, a plumb bob, a string to hang the bob, and means for supporting the half-round board parallel with the belt, as shown at *b*. The board is graduated into degrees. This can be done with sufficient accuracy by using a pair of sharp-pointed dividers, a square, and, if at hand, a set of triangles. The board is sighted along the tangent line, as shown at *b*, and the angle of the belt is read directly from the string *c* and the graduation on the board. This rig is known as the "Goniometer," and it is a very handy instrument where grading and simple leveling have to be done without an engineer's level.

Fig. 5 shows a pair of pulleys of different diameters which are connected with a very loose belt. The upper side of the pulleys are level, but the lower belt, which is the driving fold, runs at a considerable angle. It will be noted that the pull of the idle fold of the belt is 45 lb. and 46 lb., being more at the larger pulley. The belt load, or weight, in this and subsequent examples, is taken as 24 lb. to the inch of belt width. The manner of drawing the strains representing the working fold is very clearly shown and needs no further description. In Fig. 6 the same arrangement is shown as in Fig. 5, with the exception that the belt has been tightened and shows a working pull of 72 lb. and 74 lb. on the large and small pulleys, respectively, against 38 lb. and 39 lb. for the very loose belt shown by Fig. 5. It should be noted that the level fold of the

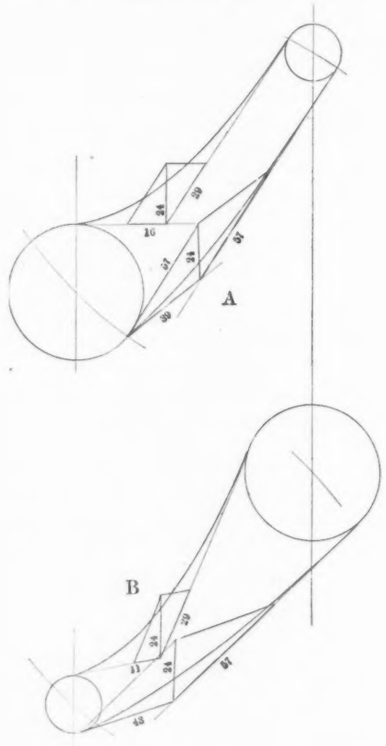



FIG. 7.—POWER OF INCLINED AND VERTICAL BELTS.

belt shows a greater strain than the inclined fold—a very convincing argument in favor of the level belt whenever it can be thus arranged. The effect of a much greater inclination of the folds of a belt is shown by Fig. 7, the two transmissions, *A* and *B*, being identical, the shafts the same distance apart, the pulleys the same size, and the angle made by the two shafts the same in either sketch. With the small pulley uppermost, as in sketch A, there is, with the same 24-lb. belt load, only 16 lb. and 29 lb. pull in the belt at the large and small pulleys on the working fold, respectively, and 39 lb. and 57 lb. pull on the driving fold of the belt. Sketch B shows about the same pulling strain, but the stress in the idle fold of the belt is very small on the smaller pulley—only 11 lb. Evidently this arrangement should be fitted with a tighter belt if work of any account is to be done.

The graphical method of ascertaining belt pull may be employed to show the benefit of making the upper fold the working fold of the belt. As shown by Fig. 8, sketch A, the strain in the belt is 38 lb. and 67 lb., idle and working folds, re-

spectively; useful stress of 67 — 38 = 29 lb. With the direction of rotation reversed, as shown by sketch B, the working strain goes up to 73 lb., the idle fold pull increasing to 45 lb., against 38 lb. and 67 lb. The total pull on the belt, as in sketch A, is 105 lb. The total pull with the loose bottom fold is 118 lb., an increase of 13 lb. to the inch width of belt. The working strain, the net useful pull, is less by 1 lb. than with the loose belt fold properly arranged on top of the pulleys.

To return to the reading of the dynamometer belt depicted by Fig. 1. Assuming that the pulleys are revolving at 200 r.p.m., the horse-power transmitted to the belt may be found as follows: Belt velocity = 2520 ft. a minute; belt pull = 15.56 lb. to inch of width; belt width = 10 in. Then 2520 + 15.56 × 10 ÷ 33,000 = 11.9 horse-power. Were there a greater load to be carried, there would be a greater difference in sag of the folds of the belt, and the difference in the amount of

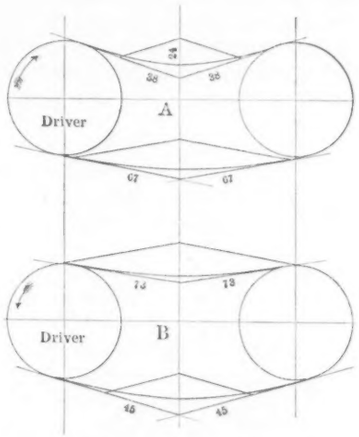



FIG. 8.—ARRANGEMENT OF WORKING AND IDLE FOLDS OF BELT.

sag for any belt may be made a constant by means of which the power being transmitted at the time the sag is measured may be ascertained with exactness.

Thus the power-transmitting capacity of any given belt depends entirely upon the weight of that belt between the points of suspension. These points are where the belt leaves the pulleys. There is, however, another factor which comes into calculation when a belt is strained to its utmost, or where a vertical belt is used. In the latter case the pull on the upper pulley will equal the width of the belt, and the strain on the belt at the lower pulley will be 0. The driving power of such a belt must, therefore, be obtained by the elasticity of the belt material, as if the belt were an elastic band; hence the poor driving power of vertical belts.

WILLOUGHBY, OHIO. JAMES F. HOBART.

### THAWING CONDUITS BY ELECTRICITY.

We are all acquainted with the process of thawing water pipes electrically, but it may be of some interest to readers to know of a case of thawing ice in telephone conduits by electricity.

A dip in a 3-in. iron conduit for telephone wires having frozen up in Stockbridge, Mass., the telephone men went to work with a thawing outfit, consisting of a block-tin tube, a force pump and hot salt water. They were, however, only able to push the tube 50 ft. into the conduit owing to its bending when they tried to enter it further. Our foreman having suggested the use of current from the street lighting mains, the central station company was finally asked to allow the method to be tried. A few lighting transformers were connected in multiple and a current of 250 amperes was sent through the 296 ft. of conduit, the sheathing of the 60-pair cable being connected to the conduit at each end in order to avoid any possible arc between the lead and the conduit. After the current had been on a half-hour only three pairs out of the 40 pairs of wire in trouble remained short-circuited, but to make certain, the current was kept on two hours longer. Unfortunately, shortly after the lines came clear all the 60 pairs of telephone wires became grounded, which was due, as was discovered later, to a crack in the sheathing, caused by the freezing of the water in the cable. It was also found that the current did not thaw out all the ice, and therefore a strong solution of hot salt water was pumped into the conduit until it ran out quite freely at the distant manhole. The salt water remaining in the conduit will, in the opinion of the cable man, prevent further freezing up. The old cable was pulled out and found to be flat in several places, one flat section being 25 ft. in length. A new cable was then pulled in in its place.

We are greatly indebted to Mr. Stephen W. Field for encouraging and assisting our experimental work.

LENOX, MASS. ROGERS ELECTRIC COMPANY.

### PAINTING GALVANIZED ELECTRICAL SIGNS.

I have noticed in recent issues numerous requests relative to painting electric signs, and having had experience in this class of work, the following method of painting the signs by means of which the paint will not peel off, may be of interest to your readers. A pound and a half of crude gutta percha should be carefully dissolved in 5 gal. of turpentine. To do this a large iron kettle should be placed over a good fire and watched so that the contents will not boil over and start a fire that could not be easily extinguished. If a vessel of generous size is employed, there will be no danger, and it is best to be on the safe side. When the contents are dissolved the mixture should be strained through several folds of coarse cheese cloth. Enough of the solution should then be mixed with burnt umber ground in oil to give a paint of the proper consistency which will work easily. This should be used as a first coat. To prepare the galvanized iron for this first coat, it should be thoroughly washed in strong, boiling soda water. This will remove all grease and acid from the metal, and as the water is hot the metal dries very quickly after being washed. If there is any small scale on the metal it should be removed with emery cloth. After being washed the metal should not be touched with the bare hands because where the hands touch it a little moisture remains and it is in such spots that the paint is liable to peel off. The sign may then be given its first coat of burnt-umber paint and afterward baked in a japanner's oven at a temperature of about 300 deg. Fahr. with a quick fire taking one and one-half hours, or at a temperature of 275 deg. with a slow fire taking three hours. The first coat is the most important, because if it sticks on the other coats will stay on. For a clear white sign, two coats of French zinc are usually sufficient if the sign is afterward finished with a good coat of white demar varnish. This makes the sign proof against weather, and galvanized signs painted as outlined above will withstand very severe climatic changes without peeling.

CHICOPEE FALLS, MASS. PETER RANSOM.

### A MULTIPLE-DRAFT GAGE.

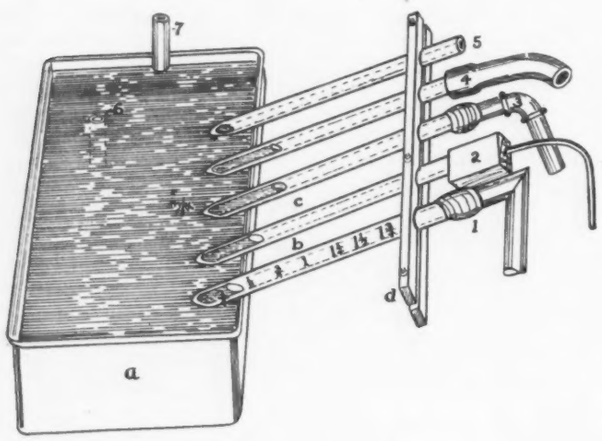
An engineer who had become interested in the reduction of the amount of draft between the base of a stack and the firebox made a number of experiments with a draft gage which he attached in succession to different portions of the boiler setting with the result that some very interesting things were observed from time to time. Among other things he noted the variation of pressure in the base of the stack when the fires were being forced, owing to the greater heat delivered to the stack with the products of combustion. He also observed that an increase in the height of the water column which was sustained by the negative pressure (below the pressure of the atmosphere—in this letter the height of water in the draft-gage glass will be alluded to as "pressure" for facility of description) took place in a gage connected with the firebox whenever the fires became dirty and in need of cleaning.

It was also observed that the pressure fell when the tubes became very dirty, thus preventing the full effect of the draft being felt in the firebox. Several openings in the shape of cracks developed in the setting and the pressure of draft was

sensibly affected by the closing of these holes. In another instance, with another boiler which was supposed to have too much tube area for the amount of opening in the grate, the engineer proved his contention by demonstrating by the draft gage that two or three of the tubes could be plugged without in the least reducing the draft pressure, while an increase in the area of grate opening increased the draft pressure.

Considerable experimenting with the draft gage, in one position and another, led the engineer to very much desire to have the gage attached in two places at the same time. He then fitted up two gages, and soon felt the need of a third and a fourth, each connected to a different portion of the interior of the boiler setting. Finally the engineer decided to construct a multiple gage which could remain permanently attached to the boiler setting, and to as many portions thereof as might be found necessary. To this end a gage was made as shown herewith, a heavy galvanized-iron tank *a* being impressed for duty as the body of the gage and fitted with a water-supply pipe *7* and an overflow pipe *6*. By means of this arrangement water would be always at the same level in the tank *a* as long as the smallest possible quantity of water was permitted to flow from pipe *7*. For the gages plain glass tubes were used, some 18-in. x ¾-in. water-line glasses being requisitioned for the purpose. A wooden clamp *d* was rigged up to hold the tubes securely in place and when the three carriage bolts in *d* were screwed lightly home the tubes were held in position as shown at *b*, *c*, etc.

The tank in this instance was located in the engine room nearly 20 ft. from the boiler, and the engineer evidently found it very hard to secure sufficient piping to connect up the different gage tubes. In the gage shown by the engraving, glass *3* was connected into the base of the stack, while glass *2* was connected into the back combustion chamber just below the




MULTIPLE-DRAFT GAGE.

back arch. Glass *4* was connected into the up-take just above the front end of the tubes, while glass *1* was connected with the interior of the firebox. Glass *5*, not yet connected, is in communication with the inside of the ashpit in order that the effect caused by closing the ashpit doors may be fully studied.

The variety of connecting tubes and the ingenuity of the engineer in adapting so many different articles to his use is an example of "getting there" which could be studied to advantage by the few engineers who do nothing to improve their conditions or surroundings. This draft gage furnishes a splendid example of how one engineer made things work even though they were not especially suited for the work. It was useless to ask the owner for 100 ft. of pipe for connecting-up the several gages, so the engineer laid hands upon everything he could find around the premises which had a hole through it and which did not leak. Gage *3* is piped with ⅜-in. gas pipe; glass *1* was connected by means of a tin speaking-tube soldered to make it air-tight; glass *2* was conected by means of some seamless-drawn copper tubing less than ⅛ in. in diameter; glass *4* was connected by means of pieces of rubber hose joined together by short pieces of steam pipe forced into the ends. The hose was simply slipped over the end of one of the glass tubes, but the other connections were made by means of a piece of tin to cover the joint between the glass and the connecting tubes, then adhesive tape was wound over the tin and a short distance upon both glass and connecting tube, thus making a strong, though homely, air-tight connection. To connect the small copper tubing a block of wood was bored to fit the glass and the copper tube, both of which were liberally dosed with shellac and slipped into place and daubed with more shellac until air-tight. The glasses were graduated to quarter inches of vertical distance between the level of the water in tank *a* and the point to which the water rose diagonally in the glasses. Thus in glass *3*, as shown at *c*, the water advanced several inches into the glass tube, while its vertical height was just ¾ in.—a fairly good draft for the base of a stack. Some of the glasses were marked with a file to ¼ in., but the engineer intends to supply a more convenient means of graduating by placing adjacent to each glass a nicely marked and figured scale which will be well shellaced to protect it from moisture and dirt.

The engineer who has arranged this gage claims that it has resulted in saving at least two tons of coal each week besides adding considerably to the probable life of the boiler and lessening his labor when firing and when wheeling ashes and cleaning fires.

Columbus, Ohio. J. H. Franklin.

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### EXCITER UNITS IN LARGE PLANTS.

While in every large plant there should be two exciters of such size that either can carry the entire direct-current load of the station, there are many other points about the exciter circuits that should call for thoughful consideration. The question of duplicate exciter buses has little effect on the efficiency of the equipment. The advantages are few, and hardly to be compared with the disadvantage of the resulting switchboard complication, requiring a double-throw field switch on each generator, as well as double-throw exciter switches, or a large tie switch to tie the buses together. It would also be very inconvenient to change the generator field circuit from one bus to the other without cutting the machine out of service. The exciter bus may be made short, and if well located and protected, the chance of trouble will be negligible.

The exciter switches necessarily carry heavy currents, and should be made of ample capacity. The clips should be carefully lined up so as to make good contact, or there will be a tendency to heat. If the switchboard is not too far distant, the equalizer connection may be brought to the board; or it can be placed on a stand near the machine. Single-pole switches are preferable to double or triple pole switches, because in case it is necessary to cut the other exciter into circuit, and the machine refuses to build up or builds up reversed, some delay would result in disconnecting the armature lead on the machine terminal board in order that the field magnets might be energized from the busbars. In the case of single-pole switches, it would only be necessary to leave the armature lead switch open, closing the equalizer and the other switch. This would put the series-field coils in parallel with the series-field coils of the running machine, and be sufficient to cause the machine to pick up properly. In an emergency, when the spare exciter would be needed immediately, this might save much delay and prevent loss of load. Although a machine of this class rarely refuses to pick up, it is still possible and of great enough importance to invite serious consideration. There should be a reliable circuit-breaker in one lead of the exciter, preferably the lead coming direct from the armature; this circuit-breaker should be set to open only on an extremely high overload, as it is very undesirable for the exciter circuit to open, except in extreme cases, as the entire load would be lost.

Philadelphia, Pa. F. E. Conrad.

## QUESTIONS AND ANSWERS

Is it safe to ground the secondaries of transformers on water pipes? R. P.

Yes. Use a grounding clamp as recommended in the National Electrical Code.

How does a polyphase meter differ from a single-phase meter? S. I. N.

A polyphase meter consists practically of two single-phase meters driving one common shaft so as to record at the total rate of the two driving elements on a single train.

In installing transformers for stepping down the voltage for a motor load, what ratio of transformer rating to motor rating it is usual to follow? J. L.

It is usual to allow one kilowatt of transformer rating for each horse-power of motor in use. In elevator work and for variable-speed motors 1½-kw transformer rating to 1-hp motor rating is sometimes installed.

Can a three-wire load be accurately measured by two two-wire meters? H. P. T.

Yes, if the load on the three-wire system is very much unbalanced, the two meters will give a more accurate result than a regular three-wire meter. On heavy three-wire loads it is usual to install suitable two-wire meters, one in each outer with pressure taps to the neutral.

Can two transformers of the same make be operated in parallel, and will they divide the load properly? S. S.

If two transformers, either of the same or different ratings, have the same inductive drop at a given current, the transformers will divide the load proportionately to their ratings. The chief requirement of transformers operating with proper division of load is the equality of impedance volts.

In shutting down a generator, how low should the voltage be before disconnecting the field circuit? W. O. M.

As a general rule all of the resistance in the field rheostat is placed in circuit before the field circuit is broken. The field switch is usually provided with a discharge resistance to absorb the kick so that no harm results when the field circuit is opened even if all of the field rheostat has not been cut in. It would be better, however, to reduce the voltage as low as the rheostat will permit.

We have a three-wire generator with a balancing transformer designed for 110-220 volt operation. We also have a 220-volt two-wire system in operation, and would like to know if the three-wire generator could be used at times to carry the load on this system. If so, what change would be necessary? H. L. M.

Insert a switch in the circuit leading to the balancing transformer so as to cut this out of circuit when not needed. The three-wire machine may then be used as an ordinary two-wire generator. The transformer might be left in circuit if necessary without detrimental results; but it is better to take it out of circuit completely.

What is the construction, use and operation of the Pupin coil? C. C. D.

The Pupin self-induction coil is employed on overhead and underground telephone circuits. The coils are inserted at intervals in the underground or overhead circuits, and serve to diminish the damping effects of the line upon the talking current. The arrangement and dimensions of the coils are so chosen that a certain decrease in the damping effect and a considerable improvement in the clearness and strength of the sound take place. For cable lines, the coils are wound on one round iron core for both wires of the circuit, and the cores with the coils are mounted in a water-tight, cast-iron box. The beginning and the end of the coils are brought out separately to a joint, so that the whole apparatus can be directly inserted in the cable line. For overhead lines the coils for the two wires of the circuit are constructed separately and each is mounted on top of an insulator. The insulator bearing the Pupin coil, together with a lightning arrester, is fastened to an iron bracket resting on an iron cross-arm. Other details of construction are not available.

How may the ratio of transformation of a transformer be determined? T. I.

Connect the two windings to be compared in parallel with a couple of cells through variable resistances of known value; as, for instance, through two arms of a Wheatstone bridge. A millivoltmeter is connected to another winding on the same magnetic circuit and the resistances adjusted until no throw of the voltmeter needle is produced on closing the battery circuit. The ratio of the windings will then be the same as the ratio of the resistances in series with them. The resistances should be large enough to make the resistances of the transformer windings negligible in comparison with them and the windings should be so connected that the fields due to the currents in them are oppositely directed.

I have been told that extremely cold weather affects the oil in oil transformers and makes them dangerous to operate. Kindly advise me if I was correctly informed? G. D.

Almost all transformer oils are said to precipitate paraffine in extremely cold weather. When this occurs the oil is robbed of its dielectric strength. However, cold weather does not affect ordinary line transformers that are always in circuit. It is only in cold climates where the plant runs all night, for instance, and is shut down during the day that such trouble is likely to occur. Moreover, no evil results have been reported on distribution networks operating at 2200 volts. It is on 10,000 up to 50,000-volt circuits that such transformer troubles usually exist, although it is not uncommon to find transformers which have been out of circuit for a couple of months during severe winter weather completely frozen up.

In Behrend's "Induction Motor" the formula for a concentrated winding is given as $E = 2.22 \times \text{frequency} \times Z \times \phi \times 10^{-8}$. I have always understood that constant in this formula is 4.44, instead of 2.22, and would be obliged if you would inform me why 2.22 is used. Will you also inform me how a lap-wound, single-phase stator winding should be connected for a given number of poles? How many slots should there be in the stator of a four-pole field with five slots per pole; assuming that a uniformly distributed lap-winding is to be used (single-phase)? Define the pole pitch of such a winding. C. T. V.

In the e.m.f. formula of Mr. Behrend, the constant 2.22 is the exact equivalent of the usual constant 4.44, because with the former constant use is made of the conductors, while with the latter formula use is made of the turns, each turn having two conductors. Commercial single-phase induction motors are wound just as though they were intended to be used as polyphased machines; in fact, one large company uses a three-phase induction motor for this purpose. Another large company uses a two-phase induction motor with twice as many coils in one phase as in the other. The latter phase winding is used for starting purposes only. Your question as to the number of slots in the four-pole field with five slots per pole, answers itself because $4 \times 5 = 20$. However, a four-pole induction motor would ordinarily have more than a total of 20 slots; 48 would be more nearly correct for a small machine. In single-phase induction motors, as well as in polyphase machines, the coil-throw is ordinarily somewhat less than the pole pitch, the value varying from 60 to 80 per cent. Assuming a four-pole, 48-slot stator, quite independent of whether the machine is to be wound single-phase, two-phase, symmetrical or unsymmetrical, or three-phase, there could be 48 coils, and each coil could be placed in slots numbered 1 to 10 throughout. If this machine is to be connected as a three-phase motor or as a single-phase motor started as an unsymmetrical three-phase machine, the coils should be connected in 12 groups, each containing four coils. These groups should then be designated as: $a_1$, $b_1$, $c_1$, $a_2$, $b_2$, $c_2$, $a_3$, $b_3$, $c_3$, $a_4$, $b_4$, $c_4$. Group $a_1$ should be connected in series with group $a_3$, and group $a_2$ should be connected in series with group $a_4$. These two series connections should then be connected in reverse series to form the windings of one phase. The windings of phase "b" and phase "c" should be similarly connected. The three separate phase windings can then be joined in either star or delta. If the machine is to be used as an unsymmetrical two-phase motor, phases "a" and "b" can be connected permanently in series to form the main winding of the machine and phase-winding "c" can be used as a starting circuit.

# Central Station Publicity.

By Andrew J. Haire, Jr.

ADVERTISING LITERATURE.

The power company in a city of 5000 population, by a well-organized advertising campaign, succeeded in increasing its business just 46.38 per cent. In 1906 the gross income of this company was $21,521.00; and in 1907 it was $31,540.14, representing a gross income "per capita" of $6.30. The main part of the publicity efforts of this company consisted in direct-by-mail advertising, supplemented by some local newspaper advertising and some personal solicitation.

In a city of 100,000 population, the power company upon an outlay in advertising of 5 per cent of its gross income realized an increase in business of 66.1 per cent. In 1905 this company did a business amounting to $137,924.65. In 1906 these figures were increased to $225,000; while the statistics for 1907 are not available at the time of writing, it is believed that this ratio of gain will be maintained, or, perhaps, even increased. To bring about this extraordinary increase, the company employed eight solicitors, advertised in the newspapers and by mail, maintained display and demonstration rooms and operated five electric signs for self-advertising purposes.

In a city of 300,000 population, the power company by judicious advertising increased its gross income in one year from $542,377 to $702,744, a total gain of 29.5 per cent. The methods followed by this company were similar to those outlined directly above. Solicitors, newspaper and mail advertising display and demonstration rooms and electric signs were responsible for the increase in business.

The general spread throughout the electrical field of the publicity spirit has been succinctly summed up by one in intimate touch with the facts and results. The report was made some months ago before the figures for the period of 1907 were compiled. The situation outlined, therefore, represents conditions only as they existed about a year ago. Since then the movement has gained even greater headway. The report reads in part as follows:

"According to reports obtained from 943 plants throughout the United States, there has been an increase of 65 per cent in the number of 'new business' departments organized in 1906 over 1905. One hundred and sixty-five plants added solicitors in 1906, totaling 331. These solicitors were employed to follow and back up the newspaper and other advertising of these plants. During the year eleven times as many plants began direct advertising as did previously, and eight times as many began newspaper advertising. During 1906 the advertising appropriations were increased by 195 of the plants reporting. For the 43 plants reporting an increase in appropriation in dollars and cents, the total is $43,250; and 33 plants reported increase of appropriations for the year in percentages varying from 25 to 615 per cent for the different states in which the plants are located."

One of the most striking features of these reports is the comparatively small outlay which produced these remarkable results. One to three per cent of the gross income is given by some experts as a sufficient expenditure on advertising to produce in this field the desired results. Others state that a maximum of 5 per cent, if judiciously expended, will bring about extraordinary returns. In one instance, as shown above, an appropriation of 5 per cent of the gross income produced an increase in business of over 60 per cent. In what other branch of business would an appropriation of 5 per cent do so much work? In the retail field it is generally necessary to devote to advertising an appropriation of from 3 to 10 per cent of the total sales to maintain business at its normal level. In the general field even a greater percentage is probably devoted to advertising. Assuredly, the electrical field is rich in commercial possibilities.

Perhaps one reason why the sums devoted to advertising purposes by central stations is comparatively so small is owing to the fact that the newspaper as a medium plays only a minor part in the campaign. Newspaper rates are everywhere admittedly high, and unless every fraction of the circulation may be depended upon for possible results it is accepted as a principle in electric power advertising that almost any other medium is generally as effective and almost always more economical.

The advertising manager of a power company whose business each year runs up into the millions said recently:

"In the average big city the character of the population is such that out of a circulation of, say, 100,000 that some newspapers may have, only one or two thousand may be possible customers. In advertising, the company must, therefore, pay to reach the 98,000 unprofitable ones along with the 2,000 prospects, and it is, as a general proposition, uneconomical to pay for all this surplus publicity. In the average small city conditions are different. Circulations are not so large, nor mediums so numerous; advertising charges are not so heavy

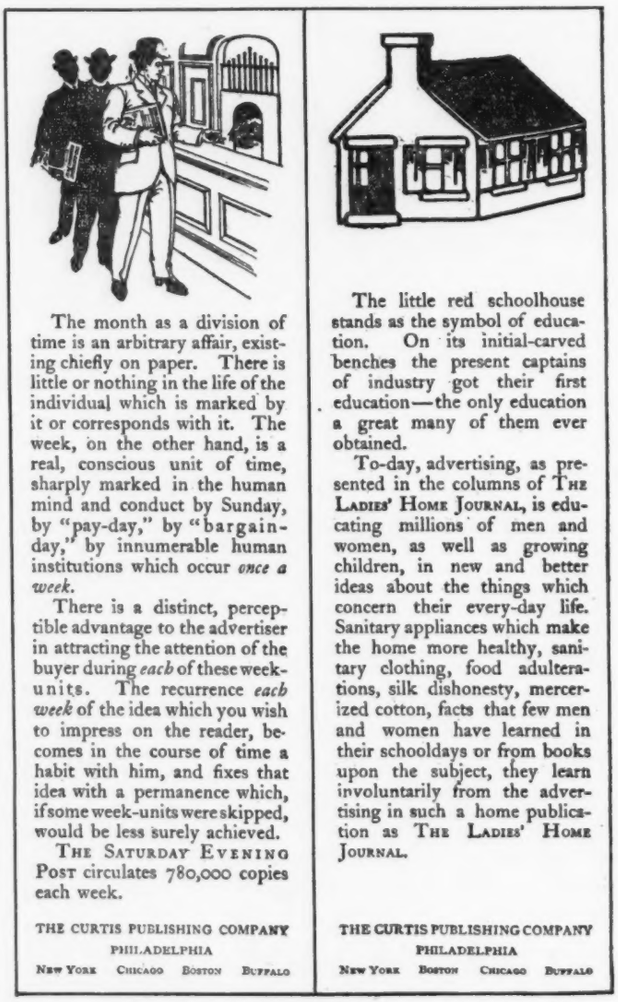

The month as a division of time is an arbitrary affair, existing chiefly on paper. There is little or nothing in the life of the individual which is marked by it or corresponds with it. The week, on the other hand, is a real, conscious unit of time, sharply marked in the human mind and conduct by Sunday, by "pay-day," by "bargain-day," by innumerable human institutions which occur *once a week*.
There is a distinct, perceptible advantage to the advertiser in attracting the attention of the buyer during *each* of these week-units. The recurrence *each week* of the idea which you wish to impress on the reader, becomes in the course of time a habit with him, and fixes that idea with a permanence which, if some week-units were skipped, would be less surely achieved.
The Saturday Evening Post circulates 780,000 copies each week.
THE CURTIS PUBLISHING COMPANY
PHILADELPHIA
New York Chicago Boston Buffalo
The little red schoolhouse stands as the symbol of education. On its initial-carved benches the present captains of industry got their first education—the only education a great many of them ever obtained.
To-day, advertising, as presented in the columns of The Ladies' Home Journal, is educating millions of men and women, as well as growing children, in new and better ideas about the things which concern their every-day life. Sanitary appliances which make the home more healthy, sanitary clothing, food adulterations, silk dishonesty, mercerized cotton, facts that few men and women have learned in their schooldays or from books upon the subject, they learn involuntarily from the advertising in such a home publication as The Ladies' Home Journal.
THE CURTIS PUBLISHING COMPANY
PHILADELPHIA
New York Boston Chicago Buffalo

FIG. I.—SPECIMEN ADVERTISEMENT; IDEAS APPLICABLE TO ELECTRIC PUBLICITY.

and a larger proportion of readers are likely to be prospects. So that, for advertising in the city of 50,000 or less, I would utilize the newspapers to a considerable extent.

"Take a whole page or a half-page once in a while on some special occasion, such, for instance, as a reduction in rate, or the inauguration of some new policy or special proposition, or a marked addition to station capacity. At other times use an advertisement each week in weekly papers and about three times a week in dailies, not all the year round, but for certain months in the year, pausing now and again to take breath and gather renewed energy for a new campaign. The size of these advertisements should not be fixed hard and fast, but should vary up from a minimum of five inches single column

or four inches double, according to the particular message it is desired to convey."

A series of advertisements published some time ago by the Curtis Publishing Company, of Philadelphia, for the solicitation of the business of prospective advertisers, strikes the writer as containing several good ideas especially applicable to electric power publicity. These advertisements occupied spaces averaging from 75 to 100 lines, single column. In smaller cities it is probable that a rate for this space could be obtained which would bring the price to an average of, say, $10. At this latter figure, such advertisements published about twice a week should not represent too great an outlay, and if the circulation of the paper among property holders was large, the specific educational effect of such advertisements should be exceedingly valuable.

The specific advertisements referred to above were published in the interest of *The Ladies' Home Journal* and *The Saturday Evening Post*. Each advertisement exploited a distinct feature of the service which these publications offered to general advertisers, and in each case at the top of the advertisement was a rough, sketchy drawing which very neatly illustrated the spirit of the advertisement. In one case, for example, where the subject of the advertisement treated of the general uplifting and educational influence of the advertisements published in these two journals, the illustration was of the little red schoolhouse so famous as the symbol of American education. In the case of the other advertisements of the series, the text matter and illustration dove-tailed together with quite the same facility and convincing aptness.

While, as a usual thing, general publicity advertisements are too vague and indefinite to be resultive of any but the most indirect results, it is yet considered advisable for the central station occasionally to devote spaces to this style of advertising. One of the best examples of this character of advertisements that the writer has seen was published by the New York Edison Company. The purpose of the advertisement

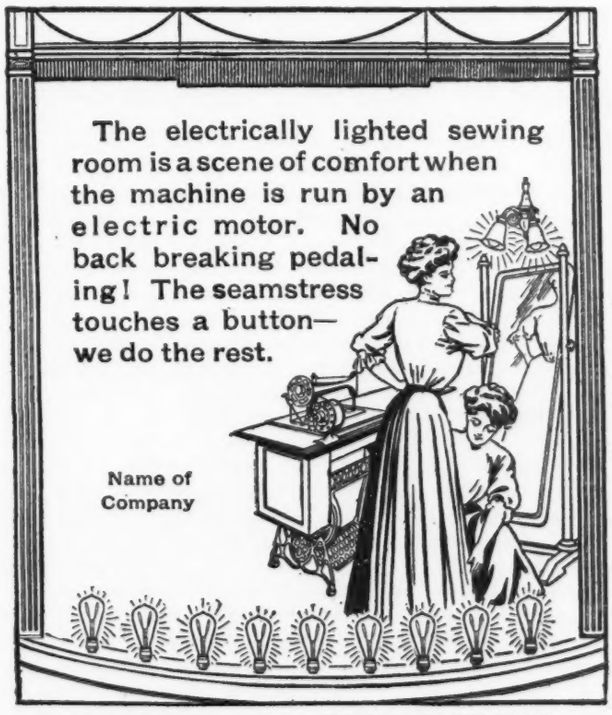

The electrically lighted sewing room is a scene of comfort when the machine is run by an electric motor. No back breaking pedaling! The seamstress touches a button—we do the rest.
Name of Company

FIG. 2.—ELECTRIC SEWING MACHINE ADVERTISEMENT.

was to exploit the wonderful elasticity and applicability of the electric current. It measured about 10 in. on two columns, and was illustrated at the top with a rough line drawing showing a section of New York's famous skyline. An irregular border of electric wires, extending down the left-hand side of the advertisement, connected the head-line drawing with a number of knife switches at the bottom of the advertisement and then continued up to about the center point of the right-hand side, where it terminated in a small electric fan, thus aptly illustrating the claim made in text matter that the power supplied by the New York Edison Company lights a whole city with the same ease that it revolves a small electric

Oh! dear little girl
With the sweet little curl,
You never looked brighter or sweeter!
Sir!, of that I'm aware
For I've just fixed my hair
With Ma's Electric Curling Iron Heater

FIG. 3.—ELECTRIC CURLING-IRON HEATER ADVERTISEMENT.

fan. The advertisement was especially well written; and as advertisers may find it interesting, the text is reprinted below:

"The New York Edison Company supplies light for everything, from the great illuminated signs up and down Broadway to the 1-cp night light in a sick room. It supplies power that whirls the great printing presses in Newspaper Row or revolves an electric fan to keep the sick room cool. It lights the whole city with the same ease that it lights a single light. It whirls a million wheels with the same ease that it turns one. This wonderful service is at the immediate disposal of any Manhattanite for any purpose for a cost much less than he probably supposes. The New York Edison rates are the lowest of any of the world's great cities."

The character of advertising which central stations, as a rule, have found most economical, most effective and most satisfactory generally is direct-by-mail advertising, consisting of form letters, booklets, folders and cards. The names of prospects to whom this mailing literature may most profitable be sent are secured in various ways. Telephone and business directories and social "blue books" often contain good workable prospects. The most productive lists, however, are generally those which are supplied by the solicitors themselves. The Brooklyn Edison Company, for instance, realizing this fact, furnishes its solicitors with blanks on which each one is required to send in three names daily, indicating also the character of the advertising to be used, whether power, signs, residence lighting, window lighting, store lighting, etc. A record card is made out for each name, and the cards are filed away in cabinets under convenient classifications. Many companies employ with considerable success this method of securing names of possible consumers of electricity.

Each different phase of the central station's activities should

have its own special series of follow-up, form letters, booklets and circulars. There should be a series devoted to the manufacturer who is a prospective consumer of electricity for operating purpose, to the merchant who is a prospective consumer of electricity for lighting and display purposes, to the housekeeper who is a prospective consumer of electricity for lighting and heating purposes and to operate the many labor-saving appliances now exploited by every central station. There should also be a series devoted to the builder or contractor who may be interested in the wiring of new buildings.

As a general rule, the advertising matter which is gotten out by the large power companies compares favorably with the publicity efforts of any branch of business, wholesale or retail. That principle which is known as "incident in advertising" is exceedingly well exercised by the advertising writers of large central stations. For the benefit of those who are not familiar with this theory of "incident in advertising"—one of the fundamentals of good advertising—it may be explained that, reduced to its essence, the idea constitutes the inclusion in an advertisement of some incident in the shape of a comparison, metaphor, simile or other figure of speech or of some reference to a well-understood fact or condition which serves as an introduction to or as an effective peg upon which to hang the "moral" of the advertisment. This "incident" may or may not be extraneous to the subject matter of the advertisement, but when properly applied, it always aids, by contrast, antithesis, suggestion, or direct illustration in making more clear and definite the argument and purpose of the advertisement. In the advertisement referred to in a foregoing paragraph as having been published by the Curtis Publishing Company, this "incident" was supplied by the reference to the "little red schoolhouse."

The writer has before him several pieces of advertising literature which were recently published by the Edison Electric Illuminating Company of Brooklyn. In every case the subject matter of the advertisement is introduced by some "incident." For example, in one folder, which is styled "Increased Cost of Living in Brooklyn" the text opens with the query, "Has the cost of living in the Borough of Brooklyn increased in the last 10 years?" Facts and figures are next quoted to show that the price of all commodities has increased in that period just 29.2 per cent and the advertisement is concluded with more figures to show that the cost of Edison service, on the contrary, has dropped 40 per cent in two years. In another folder, styled "WHY?" the opening line reads, "Why did you discard kerosene for gas?" And still another begins, "When you undertake to supply your family with food, clothing, medicine, nothing but the best and finest articles are good enough. Second rate food or medicine wouldn't suit you at all, now would it?—Then why put up with second-rate light?" In each case, the advertiser stating the "incident" as a premise, logically, though concisely, develops his argument, and the text matter always concludes with some such proposition as, "Write us to-day and our man will call to-morrow," or "Let us tell you how much it will cost to wire your house," or "We will be glad to take up the matter with you. Write us about it."

There are few points more important for any advertisement writer to master than this principle of "incident in advertising." It affords an engaging means of opening an advertisement, and, when fully understood, it effectively holds down the writer to the specific argument at hand and prevents that aimless circumlocution which represents the work of so many advertisers.

It is believed that the best advertisement for the central station is one that is crisp, terse and brief. Sentences should be simple and not intended to convey more than one single thought—in other words, avoid conjunctions. The paragraphs generally should not contain more than three or four sentences, and, whenever possible, the entire advertisement should be restricted to as few paragraphs as possible.

Good printing and good stock are always essential in electric power publicity. Electricity is a commodity of interest mostly to business men and property holders. It is, in many senses, even yet more or less of a luxury, and its advertising, therefore, should be high-grade to correspond with the probable tastes of its possible consumers.

## The Advantages of Electric Drive for Textile Mill Equipments.

By Norman G. Meade.

At the present time there are very few industries that do not use electric motors to some extent, and textile mills are rapidly coming to the front as exponents of this modern drive. The large hydro-electric plants recently built in the South find the largest outlet for their energy in the cotton industry. Some of the reasons for the adoption of electric drive are that under certain conditions it is much more economical, owing chiefly to the possibility of connecting the motor to the machine to be driven, or placing it in close proximity to the work, dividing the machines into groups and driving each group by short lines of shafting. The former arrangement eliminates shafting and belting entirely, and the latter reduces the size and length of the shafting, ensuring better alignment and less friction loss compared with long lines of heavy shafting and main belts as in the older forms of engine-driven mills.

Electric drive has the advantage that power distribution is subdivided into many units, each of which is independent of the others. The units or groups are easily controlled and may be stopped for repairs if necessary, or if not producing may be cut out of service, thus stopping all expense on the section. To a certain degree the grouped method of electric driving permits a better arrangement of manufacturing conditions—the location of machines without respect to other groups, so that each set may be placed in the direct line of production. It permits the use of power anywhere within the ordinary limits of an industrial plant, it only being necessary to locate a motor and to connect it to a source of supply by relatively small wires which are capable of unlimited additions and extensions, and when once installed do not require expensive maintenance as is the case with steam pipes, compressed-air pipes, ropes, belts or other mechanical methods.

When the motor forms an integral part of the machine, as with individual drive, the ideal method is found, and this method is coming more prominently to the front as the advantages become more generally known. There is a general reduction in cost on account of the elimination of a number of parts required when belt driven, such as line shafts, belts and pulleys, which in a degree offsets the cost of the motor and controller.

Some important advantages of individual drive are: lighter construction of building, due to absence of shafting, better diffusion of light, both natural and artificial, due to the absence of belts, and full and positive power at the machine. The belt is a flexible method of drive at its best, and when called upon for heavy service, slips and introduces an uncertain factor in the power system, whereas, on the other hand, the electric motor is automatic in its regulation, requiring and delivering power in direct proportion to the demand upon it, and will, in case of emergency, sustain large overloads for a reasonable length of time. Thus, a properly designed machine is capable of maximum production when motor-driven. The most important feature of the individually-driven machine is increased productive capacity, due to an even and easily manipulated speed control. Another important feature is the elimination of oil and dirt common to belted installations, as a single spot caused by a drop of oil falling upon a piece of velvet or silk in the process of weaving is enough to ruin the goods, and on this score alone it is safe to say that the use of direct-connected motors is often justified.

For manufacturing processes where constancy of speed is an essential requisite, motor-drive will be found to be of great service as a means of increasing production, due to uniform

speed under constant or varying loads. This is partly accomplished by an elimination process whereby the flexible members of the transmission are omitted. It will be at once apparant that a device as flexible as a belt must have a tendency to slip; that is, to tighten or loosen with changes of load. This introduces certain irregular fluctuations which, if avoided, insures an increase in output.

The induction motor is best suited for textile and other work where the machines operate at a fixed speed, as its revolutions are maintained fairly constant with changes of load. As to the control, where motors are direct-connected to textile machinery, it is customary to connect the switch or clutch controlling the motor to the standard shipper lever of the machinery in question, so that the operators have nothing new to learn in this respect, the machines being started and stopped exactly as they would be in case of belt drive.

There are certain machines in bleacheries and in calico printing plants that require a varying speed of the machines, such as tentering machines, drying cans and printing machines. It has been the custom to operate this class of machinery by means of a steam engine, the speed changes being effected by throttling the steam. This, in a way, is effective, but very uneconomical, for the reason that the small engines require several times as much steam per horse-power as would be required by a large engine. It may be argued that in the case, for instance, of drying cans, the exhaust steam is used for heating; the objection to using the exhaust steam for heating this class of machinery is the detrimental effect upon the cans of more or less oil and foreign matter which it contains. The latest and most approved practice is to use low-pressure steam from boilers designed to furnish steam for heating purposes, and to operate the cans by electric motors.

The facility with which an electric motor may be controlled permits a very much more exact operation, and in the particular instance of a calico printing machine offers a means of abtaining finer register, the exact speed required for the work in hand, and in the "making ready" process considerable economy is effected, it being possible to move the rolls just sufficiently to indicate to the operator that the right register has been obtained, whereas with a steam engine the awkwardness of control usually involves considerable waste. The motor as applied to this class of apparatus is much more compact than the engine; it can be placed out of the way, and the controller being a comparatively small piece of apparatus can be located at a point which, while entirely accessible to the operator, will not in any way interfere with his movements. There will be no dripping pipes to take care of and no oil thrown on the machine or on the goods, as with an engine-driven machine.

The advantages of electric drive for textile mills can, in general, be summarized as follows: Electricity may be readily distributed to any mill section by the installation of the necessary wires, which may be easily and quickly erected. It is not required that the wires follow any predetermined direction or occupy any definite location. The motor can be located at the most convenient point for the driving of a section of machines, room or floor, thus reducing to a minimum the number of belts between the motor and the driving head of a machine. The motor may be located upon the machine, thus eliminating all belts and flexible factors in the power system, applying direct and positive power to the machines at a constant rotative speed. Uniformity of speed is secured, due to the even rotating speed of the prime mover, which is transmitted with exactness to the motors. In cases where the motors are distributed on the group system, the improvement in the producing capacity is very noticeable. Where motors are directly applied to the machines the improvement in the quality and the amount of the product, as well as the decreased attendance, is very marked, it being a great improvement over the group system of motor driving. With a motor directly attached to the textile machine the speeds are maintained at the theoretical maximum, thus accounting for the increase in production. Extension to the mill may be made without reference to the power requirements other than to provide additional motors. The machines may be located with the length of the mill or across the mill, as may be desired. Liability of stopping the mill due to breakdown of the power system is reduced to a minimum. Independent operation of any section can be had if the production is out of balance, if overtime work is required, or in case of breakdown without reference to any other section. Records may be kept of the consumption of each motor, and any deviation from the normal operation of the machine will be immediately indicated, thus showing the mechanical department the necessity for an examination of the producing machinery.

## Concentrated Effort in Central-Station Advertising.

BY J. O. LITTLE.

The general who picks out a weak spot in the enemy's fortifications and keeps hammering away at it stands a much better chance of success than one who attacks first here, then there, and gives the enemy a chance to recover while he is moving from point to point.

So it is in advertising. The advertiser who out of several propositions selects the one whose acceptance by the public offers the least resistance and keeps hammering away at it, stands a better chance of success than one who distributes his efforts and skips from one proposition to another. After a demand has been created for one thing and people find it a profitable investment, confidence in the advertiser is established and half the battle is already won for his other propositions of a kindred nature.

Take the case of motor-drive and central-station service. Naturally one who is thinking about adopting motors wants to do some experimenting on his own account, and he wants to experiment on a small scale instead of a large. He doesn't want to try a half dozen different applications at once, but a single one. If he finds that this application means economy and convenience, he is in a mood to take other applications into consideration.

He wants to make a trial of some one application. Therefore it is better for the central station to pick out some application that makes a good demonstration and concentrate its advertising efforts upon it. A small expenditure so concentrated means more than a large expenditure spread over the whole field of application. One who is told every week for six weeks of a different motor application is liable to become confused by the magnitude of the proposition, and to decide that he cannot afford to consider it. On the other hand, one who is told every week for six weeks of the same application, and impressed with one or two points in its favor at a time, is very liable to decide that he'll try it just for luck. After he has tried one application and found it to his liking, then is the time to approach him with another and another. What the central station wants is to sell energy, but what it must advertise are motors and their applications. After the motors have been sold, the energy sells itself.

A motor that offers a simple, everyday application and that can be attached to the lighting circuit, offers the greatest possibilities in advertising. Moreover, a motor that goes into the home is preferable to one that goes into the factory, for the reason that a man has more leisure at home and is more likely to form an intimate acquaintance with it. Even if your ultimate object is to get him to use motors in his factory, the best place to begin on him is at home. Let him see what a motor will do there and it will not take very much argument to persuade him that it will not do less in the factory.

If it were not for the fact that the fan motor is looked upon by the layman more as a fan than as a motor, it would undoubtedly be the best application upon which to concentrate advertising. Few people ever saw the blades of a fan driven by anything but a motor and so they do not think of it as a substitute for hand or mechanical power. The fan has almost outgrown its parentage. Many people look upon it as belong-

ing to the electric light rather than to the motor family. If you were to ask the average man who has used electric power only in connection with his fan what he knows about motor drive, he would perhaps answer "nothing." But ask a man whose wife has a sewing-machine motor the same question, and he will be apt to entertain you half an hour.

For many reasons the sewing-machine motor is an ideal application for a central station to advertise. Sewing machines are used everywhere and almost every family has one. Every woman who sews knows of the backaches and fatigue constant pedaling produces, and is thankful for the complete emancipation the motor affords. Any one can use the sewing-machine motor. Through the use of a motor which will fit any type, the sewing machine becomes the simplest and most economical of machines to equip.

It is a splendid example of the convenience and economy of electricity. An advertisement of the sewing-machine motor appeals to both men and women, and thus its force is doubled. If a man is interested in electric drive at all, he won't mind spending a few dollars to try a motor on the sewing machine. If he is not yet interested in it for his own purposes, he may have enough thought for his wife's welfare to get her a sewing-machine motor. When she once has it, he will become interested in electric drive in spite of himself.

Few men are so lacking in curiosity or interest as not to want to "monkey" around the sewing-machine motor a few times at first, and this "monkeying" has real advertising value to the central station. It's an introduction to the use of electric power that should, by proper follow-up methods, lead to many other applications, both in the home and in the factory.

The sewing-machine motor is one that serves as a good basis for comparison. With proper care, one should last long enough to reduce the investment to less than a cent a day. The energy consumption of a good motor is about that of a standard lamp. These figures make a strong argument in advertising, and when the motor becomes a fixture in the household, other applications can be compared to it in cost and energy consumption.

Then the influence of a sewing-machine motor goes far beyond the immediate family. No woman who gets one ever keeps that fact to herself. She exhibits it to her friends and callers and shows them how it operates. She is proud of it, and when she goes to the card club she refers in the most casual manner to "my sewing-machine motor." When she goes to the sewing circle she pauses in her work, heaves a sigh and says, "My, I wish I had my sewing-machine motor here; it's such a help." To say with the poet, "Our loving friends advertise us" is putting it mildly.

The central station that makes such an application the central figure of its advertising and fails to get people's attention, can't expect to get them interested in anything electrical very soon. Let them once get interested to the extent of trying the sewing-machine motor, and the percentage that actually become enthusiastic over it will be surprising high. When people once become enthusiastic over one application it in itself is the best advertisement the central station can have.

## A Sensational Advertising Scheme in Denver.

The following quotation from a recent issue of the Denver *Post* describes a remarkable advertising scheme recently worked by the Denver Gas & Electric Company:

"The mysterious Mr. Bountiful, impersonated by Mr. C. N. Stannard, secretary of the Denver Gas & Electric Company, last night ran the gauntlet of an unusually large crowd between the offices of the Denver Gas & Electric Company and the downtown store of the Scholtz Drug Company with $50 in his outside left-hand pocket within the reach of all and offered the first man or woman who should indentify him the privilege of simply reaching up and getting the money.

"As the exploit had been previously advertised, the crowd which filled Curtis Street at Sixteenth for the space of a block each way was as great as if Bryan, instead of coming to town on Monday next, had come by balloon and dropped suddenly into the midst of the metropolis.

"'There he goes!' 'That's him!' 'Wait a minute, partner!' 'Oh, I've got you, Mr. Bountiful!' The air was full of such exclamations. And at the same time hundreds were exploring the outside pockets of other hundreds without avail. It was a pleasant, jocular crowd, but there was real excitement when shortly after the clock struck 8 a half dozen young fellows shouting, 'Here he is; he's got the money,' rushed upon an inoffensive young chap who almost breathlessly declared he had only car fare. It wasn't any use. The gang had been laying for him, and from plans and specifications which they had received they felt certain of their prey. It was useless for the young man to protest. They swooped down upon him and were 'frisking' him properly when Detectives McNeil and Kenney, assisted by Sergeant McIntyre and a squad of police, tore them away from their victim, called the patrol wagon and bundled them off to jail.

"Taking advantage of this diversion the real Mr. Bountiful hastened along, clinging closely to the walls as he went down Curtis Street, until he reached the corner of Sixteenth, when he hastily bobbed into the drug store where, seeing Mr. Scholtz, he rushed up to the waiting proprietor and shouted, 'Take it; it's in my outside pocket'; whereupon Mr. Scholtz deliberately drew forth the money which, by these devious ways, the Denver Gas & Electric Company made its contribution to charity.

"A large part of the excitement of the occasion grew out of the fact that the Denver Gas & Electric Company, in order to emphasize the value of its products and its universal necessity for direct advertising, caused the lights on the block between Sixteenth and Seventeenth Streets on Curtis to be completely turned off for a short time."

## New Business in Jersey City, N. J.

By William H. Stuart.

In the year 1882 the Baxter Electric Light Company, of Jersey City, was incorporated with the object of "establishing and building electric-lighting stations and furnish electric lights for public and private use." Its object was never accomplished, for in the following year, Nov. 20, 1883, the Baxter Company was reorganized under the title of "The Jersey City Electric Light Company." A small station was built on Bay Street and was known as the Bay Street Plant. This plant became overloaded and the company built a new station on a larger piece of property, at the corner of Wayne and Fremont Streets. A description of the business and the station equipment is given by an old pamphlet issued by the company in 1890 and distributed throughout the city by them. "This station is said by experts to be one of the best working plants in the state. The station has 3100 connected incandescent lamps of 16-cp equivalent, a switchboard capacity of 9600 16-cp equivalent, a machine capacity of 4800 16-cp equivalent; 313 arc lamps are connected with a machine capacity of 430. There are 40 miles of arc wires, 12 miles of incandescent wires, and six miles of power wires."

In the following year, 1891, a solicitor was engaged and put to work securing business which required no line extensions. Considerable progress was made by the solicitor in the lighting end, power at that time not being the thing it is to-day. An effort was made to further his efforts by advertising matter printed in circular form and also using the daily newspapers. This campaign of education met with fairly good results.

About the year 1900 the company changed hands and became a part of the "People's Light & Power Company," operating electric-light and power companies in Northern New Jersey. The new company immediately reorganized the new-business department and installed a new commercial department. The working force consisted of a contract agent, one power and appliance solicititor and four light solicitors. The city was

finally divided up into four districts, and each district was the exclusive territory of the solicitor apointed to it. The power solicitor was given the run of the whole territory and all "bites" uncovered by the lighting solicitors were turned over to him. The contract agent covered the whole territory once every two weeks, noting building operations and growth especially. A contract register was drawn up, in which was entered the signed contracts, which were given a number. The register contained the name of the solicitor, the number of lamps or size of motor connected, and the name and address of the consumer. At the end of each month a summary was made of the month's business, and each solicitor informed of his standing in the amount of business done. The plan of morning meetings was introduced, at which occasionally men with a reputation gained in the mechanical and commercial fields of the electrical business were asked to address the solicitors in a short, practical talk. At the ordinary morning meeting, methods were discussed, new ideas were presented, and any particular opposition met with by the solicitors during the day was presented and discussed for the benefit of the others. At one time, to instil additional or new energy and life in the contract department, cash prizes were offered the solicitors in amount of $5 for the first, $3 for the second, and $2 for the third man at the end of each month, based on the number of new contracts he had signed up and turned in. This plan was used three months and then stopped.

Advertising became an important part of the work. Descriptive matter was prepared and distributed by mail or in person by the solicitor. Various methods were used or one scheme was used in various forms. Small pamphlets, the back of the monthly bills, pasters which were placed on the bills, newspapers, the wagons and other property of the company were all used. The advertising forms were generally illustrated and drawn up in as catchy and attractive a form as it was possible to do. The various uses of electric energy were each fully taken up and brought out by these circulars.

About 1905 the company moved its office to a very commodious and centrally located building on Newark Avenue, running through to Montgomery Street. More persons passed here in cars and on foot than perhaps any other point in the city. There was no change in the new-business work, as it was carried on at the old office, with the exception of the show windows. In the new office there were four very fine windows for the display of goods, two on each street. The windows were kept in as inviting and attractive a manner as systematic and intelligent display could make them. One window contained an electrically-driven pump with a glass tank and was kept running all day and during the evening. In the opposite window a display of lamps was alternated with displays of novel electrical devices, such as a large windmill containing 100 or more small colored lamps, the arms of the mill being turned by a small motor. In the third window small motors were displayed, which were changed often. One week a sewing machine in operation was displayed, next week a meat chopper, etc. The fourth window contained exhibitions of heating and cooking appliances, which were constantly changed about.

In the show room proper, everything electrical is kept, neatly arranged and in a manner for easy and quick connection, so that a practical demonstration can be easily made. On the outside of the building over the door a large sign has been erected reading "Light and Power," which is operated on a time switch.

Lately the company has been consolidated with the gas company under the name of the "Public Service Corporation." The two offices are now occupying the same building. This has necessitated the allowing of the gas exhibits an equal space, but the methods have not been changed. In the soliciting, the territories allotted to each solicitor were rearranged and the men shifted around. A card record has been made and kept of every house in each man's district.

That the company has hit the right method in attaining new business is evident in the rapid increase in the amount of business and the fact that there has never been from the start any agitation politically or otherwise against the policy of the company, which has succeeded in gaining the good will and confidence of the citizens. The rate for energy has been steadily pushed down from 18 cents to 10 cents per kw-hour as a basic rate for lighting service.

Along the free sign proposition the company has for some time given both the panel and the block letter sign, although lately the block letter sign has been done away with. The signs were hung free with all the necessary wiring, lamps, etc., ready to light. This policy was instrumental in filling Jersey City with signs, which are built and painted in novel ways. Several of the largest merchants have installed large "talking" monogram signs and large ornamental and unique signs worked by a flasher. One enterprising merchant has erected a large sign, operated by a flasher, showing a skyrocket effect with colored lamps. It is placed in a vertical position at right angles with the building. A streak of white runs zigzag up the sign and bursts into a flood of dropping colors as the rocket bursts; then after a fraction of a second of darkness the name of the store flashes up and remains 30 seconds.

In the motor business a very creditable increase has been made. Very liberal power rates are in force and motors are sold and all wiring under 100 ft. is included in the cost of the motor. Standard sizes and makes of motors are kept in stock and are ready to set up in quick order so that rush orders can be accommodated. Appliances, cooking, heating and flat-irons are put out on trial for 30 days, and if not wanted can be returned and energy charges are made only.

## Tungsten Lamps in Competition with Gas.

Mr. H. A. Fee, manager of the Citizens' Light & Power Company, of Adrian, Mich., has recently replaced gas arcs in a drug store with tungsten lamps, which give much more illumination and reduce the cost, including the cost of lamps, from $67.69 for 1000 hours to $52.96, the lamps burning the same number of hours. The store was formerly lighted by 24 8-cp lamps in ceiling receptacles, taking 711 watts and giving an average candle-power for 1000 hours below 180. This installation was replaced by three 3-burner gas arcs, consuming gas at $1.40 per 1000 cu. ft. The cost of gas for 1000 hours was thus $61.69, and adding to this $6 for maintenance (25 cents per month per lamp), the total cost for 1000 hours was $67.69. The tungsten installation consists of 12 40-watt lamps in ceiling receptacles, each taking 437 watts and giving a light averaging considerably over 32 candle-power. The rate for this business to 9 p. m. is 8 cents per kw-hour, making a cost per 1000 hours of $34.96 for energy, and adding the cost of the lamps—$18—makes the total cost $52.96. Tests covering 570 hours of burning under voltages 5 per cent normal during two-thirds of the time, show that tungsten lamps will stand such variations and maintain their candle-power.

# LETTER TO THE EDITORS.

## Ice Storms in Georgia.

*To the Editors of Electrical World:*

SIRS:—In your editorial on "The Use of High Voltages" appearing in the first issue of April, you state that "one does not have ice storms in the South." You are in error so far as this section of the South is concerned, as we have very severe ice storms in this portion of the country, and it is here that one finds the most extensive and highest voltage transmissions.

The writer has for several years past been constructing and operating high-tension lines in this vicinity, one of which is the highest voltage transmission in the South, and we have to provide against ice when laying out the steel towers and lines.

On Feb. 5, 1908, there occurred one of the most severe ice storms ever experienced, the cables of the 50,000-volt tower line being swollen to 2¼ in. in diameter with ice and the insulators were also heavily covered with ice. The average span in the

line is 500 ft., though there are two 1000-ft. spans, the line being designed for 1-in. coating of ice at 10 deg. below zero with wind at 40 miles per hour and a factor of safety of two under these extreme conditions.

We did not have a break in the line during the ice storm, but undoubtedly it would have been disabled if provision had not been made for such storms.

The charging current of this line represents 750 apparent kilowatts, and when the insulators were ice-covered the ammeters showed twice as much current as normally demanded to charge the line, the extra current probably being due to leakage over the ice-covered insulators, as the current became normal when the ice melted off.

GAINESVILLE, GA. F. P. CATCHINGS.

# DIGEST OF CURRENT ELECTRICAL LITERATURE

## Dynamos, Motors and Transformers.

*Modified Cascade Systems.*—A. HEYLAND.—The first part of an illustrated article discussing his so-called "modified cascade systems" (which have already been noticed in the Digest) and their use for locomotives, elevators and rolling mills. There are three different methods possible, but the common principle is that the armature of a slip-ring alternating-current motor is connected with a mechanically independent auxiliary motor. The latter impresses the voltage corresponding to its excitation on the armature of the first motor, and at the same time this auxiliary motor transforms the power taken from the first motor into direct current or into alternating current of variable frequency and delivers it to a second motor which is the working machine. The first system is shown in Fig. 1. *A* is the main or primary motor. *B* is the second motor or the working motor. *C* is the auxiliary motor which is coupled with the direct-current machine *D*, so that the alternating current taken from *A* is transformed into direct current which is supplied to *B*. The auxiliary motor *C* is a synchronous ma-

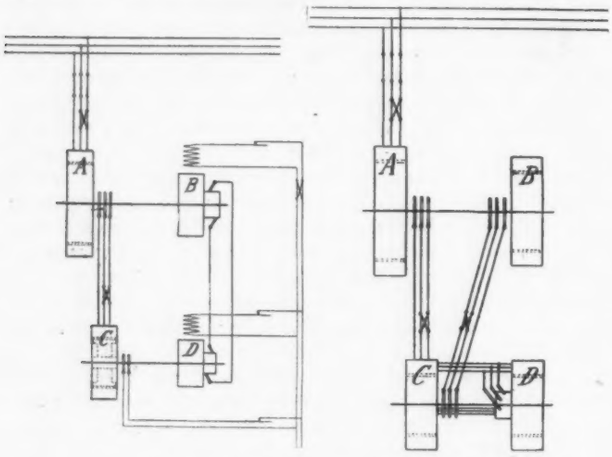



FIG. 1 AND 2.—MODIFIED CASCADE SYSTEMS.

chine, which is excited with direct current so that the voltage impressed on the armature of *A*, the field flux, the phase difference and the torque of *A* can be regulated at will. The disadvantage of this arrangement is the fact that *C* is a synchronous motor which may present difficulties in reversing the direction of rotation. The second system is illustrated in Fig. 2. *A* is the main motor. *B* is the working motor, both being normal induction machines. *C* is the auxiliary motor which acts simultaneously as a frequency transformer, and *D* is an auxiliary machine coupled to *C*. The two auxiliary machines, *C* and *D*, consist of a slip-ring machine and an alternating-current commutator machine. Alternating current of variable frequency is taken from the slip rings *C* supplied to *D*, while the current taken from the armature *A* may be supplied either to *C* or *D*, according to the arrangement. The third method which the author begins to describe is intended to combine the advantages of the first two methods. The object of the whole arrangement is to provide ideal speed regulation, any desired torque in starting or reversing the working motor, and compensation of the phase difference, with the main motor connected directly to the net work. The article is to be concluded.—*Elek. Zeit.*, April 2.

*Commutation.*—R. GOLDSCHMIDT.—A further reply to Menges' criticism as to the commutation problem and the covering of armature slots. The writer points out that the saturation of the bridge pieces is due to fringe lines from the poles and tooth saturation, and not only due to the fact that they are in parallel with the rest of the armature. This only produces an initial flux in them. It is also pointed out that iron bridges over a certain thickness influence the commutation unfavorably, and it is asked whether this agrees with Menges' theory.—Lond. *Elec.*, April 3.

## Lamps and Lighting.

*Osram Lamp.*—Some notes on patents of the German Welsbach Company for making the osram (tungsten) lamp. Some incidental information is very interesting, for instance, that the leading-in wires which support the filaments give off steam. This is due to the fact that the leading-in wires become oxidized when heated, and if a formation process by means of reducing agents (hydrocarbons, etc.), takes place, steam is set free, the hydrogen combining with the oxygen of the oxide. This steam is always detrimental and must be avoided. Another interesting observation is that when the raw filaments are heated by means of direct current in order to sinter them, the filaments are often distorted in a certain direction. This has been found to be due to the action of the magnetic field of the earth or to the magnetic field within the working room, and the distortions of the filament are avoided if the magnetic field is screened off.—*Zeit. f. Beleucht*, March 20.

*Tungsten Lamp.*—The method of J. Lux for making tungsten filaments consists in mixing finely powdered metallic tungsten with powdered zinc oxide or zinc sulphide and an organic binding material. The quantity of the latter must be limited so that the finished filament contains no carbon. The mixture is made up into a paste which is pressed into filaments which are heated in absence of air. These filaments are then brought to incandescence by means of an electric current in an inert atmosphere or in vacuo, whereby the zinc oxide or zinc sulphide reacts with the carbon, and carbon monoxide and zinc vapor are given off. The filament thereby contracts considerably and sinters together. Filaments which have originally a diameter of 0.1 mm get a diameter of only 0.01 mm after having been formed.—*Zeit. f. Beleucht*, March 10.

*Tungsten Lamp.*—The Siemens & Halske Company is now taking up tungsten lamps. One of the methods patented by it is to heat ammonium tungstate to about 300 deg. whereby ammonia is given off. After treatment for a certain time the product obtained is boiled for a short time in a limited amount of water whereby a tough paste, which is as sticky as glue and can be formed into filaments, is produced.—*Zeit. f. Beleucht*, March 30.

*Boron Lamp.*—After describing Kuzel's colloidal method for making tungsten lamps, etc. (which has been noted repeatedly in the Digest), it is stated that boron and silicon may also be made into filaments by an analogous method. Moreover, filaments of nitrogen compounds with boron or silicon may be made.—*Zeit. f. Beleucht*, Feb. 29.—The German Welsbach Company has also taken out patents for boron filaments. One method of changing boron which is a non-conductor, into an

allotropic modification which is an electric conductor, is by pressing the pure amorphous boron without any binding material into a rod form and then fusing it in a vacuum or in an indifferent atmosphere by means of a mercury arc which may be magnetically directed upon the boron.—*Zeit. f. Beleucht,* March 20.

*Increasing the Specific Resistance of Metallic Filaments.*—A note on a method of H. Kuzel for increasing the specific resistance of a metallic filament of tungsten, etc., by producing a solid solution of boron or silicon or carbon in the metallic filament. For this purpose the tungsten filament is brought into contact with a limited and relatively small amount of boron or silicon or carbon and heated to white heat. It absorbs the boron, etc., but the metallic surface remains as bright as before. The electric specific resistance may be increased in this way to 3, 4, 10 or more times its former value. While the consumption in watts per cp is not changed, the color of the light emitted by the filament is changed; for instance, a tungsten filament the resistance of which has been increased by carbon is of golden or orange tinge, while if the resistance is increased by means of boron the light has a green tinge.—*Zeit. f. Beleucht,* March 10.

*Increasing the Specific Resistance of Metallic-Filament Lamps.*—The Allgem. Elek. Ges. increases the resistance of tantalum, tungsten, etc., filaments by adding an oxide of yttrium, ytterbium, etc. The ytterbium oxide is said to be especially suitable. If other oxides, like zirconium oxide are used, the oxide is electrically decomposed when in use and the vacuum in the lamp is reduced. If ytterbium oxide is used the vacuum remains excellent and the life of the lamp is long. Such filaments may be used with direct current as well as alternating current. They have a positive temperature-resistance coefficient. To obtain a considerable increase of resistance the addition must be at least 5 per cent and may be brought up to about 40 per cent.—*Zeit. f. Beleucht,* March 30.

*Increasing the Ductility of Brittle Metals Like Tungsten; Thorium Filament.*—The Siemens & Halske Company surrounds the tungsten wire with a cover of a more ductile metal like copper or iron and then rolls and draws the wire in a highly heated state. Electric heating may be employed. The tungsten is thereby protected against the influence of the atmosphere and is prevented from cooling quickly. Further, its mechanical strength is increased and greater uniformity and reliability during drawing is obtained. Simultaneous heating is favorable, since tungsten is in general much more ductile when hot than when cold. After the drawing process the copper or iron cover may be removed chemically or by other means. In the same way it is possible to first make a tantalum core, surround it by tungsten, and cover the whole with copper or iron. In this way a filament with a core of tantalum and a cover of tungsten or an alloy of tungsten is produced. Thorium filaments can be made in the same way by stamping thorium containing more or less oxide into a hollow tube of ductile metal and subjecting it to a rolling and drawing process. In the same way alloys or thorium with tungsten or tantalum may be treated.—*Zeit. f. Beleucht,* March 30.

*Pitch Blende for Incandescent Lamps.*—A note on a method of A. Bourdos and R. Rothschild for making filaments from pitch blende. The pitch blende after having been treated, as will be described below, is mixed with india rubber so as to obtain a plastic mass from which the filaments are formed. The plastic mass may also be used as a cover for ordinary carbon filaments. The treatment of the pitch blende consists in first immersing it in a solution of potassium or sodium chloride or hydrochloric acid, until gases no longer escape, due to the reaction. The pitch blende thereby becomes a porous mass, while a fine powder settles on the bottom of the vessel. This porous mass and powder are thoroughly washed and heated electrically to red heat until vapors cease to escape. Any lead or tin, etc., is removed by further heating from the refractory residue, and this is then powdered and mixed with india rubber and the filaments are prepared. They are heated in an air-tight chamber containing powdered charcoal and graphite so as to reduce any oxides. The final formation of the filament is carried out by heating it in a hydrocarbon gas in the usual way.—*Zeit. f. Beleucht,* Feb. 29.

*Combined Carbon-Filament and Mercury-Vapor Lamp.*—A note on a lamp patented by W. Modrow. The carbon filament is brought to incandescence in an atmosphere of mercury vapor and an indifferent gas. For this purpose a drop of mercury is put into the incandescent lamp, together with such an amount of an indifferent gas that when cold the gas pressure corresponds to from 5 to 30 mm of mercury. When the mercury drop is in the hottest zone of the incandescent lamp it evaporates, and simultaneously the candle-power of the carbon filament lamp is increased by from 50 to 80 per cent.—*Zeit. f. Belucht,* Feb. 29.

*Cost of Electric Lighting.*—A note on a case recently decided in court in England between a municipality and a lighting company. According to the contract the city had to pay to the company a return equal to 10 per cent over "the actual cost of generating the light." The question was what to include within the actual cost. The court decided that it includes not only the generation of energy, but also its transmission to the points where the light is finally produced; further, that it also includes depreciation. Concerning the latter point the decision reads as follows: "The cost of the plant forms part of the actual cost of generating the light, but as the use of that plant would extend over several years, it could obviously not have been intended that the whole of that cost shall be charged during the first quarter of the contract. But the same objection does not exist to a distribution of the actual cost of the plant over the whole period of the life of such plant. The effect of allowing a certain sum for depreciation in the quarterly accounts of the plaintiffs would simply be to distribute the actual cost of the plant over the whole period during which it would, in the ordinary course, be of any service in the generation of electricity and light." The cost of insurance was also allowed.—Lond. *Elec. Rev.,* April 3.

*Store Lighting.*—G. H. STICKNEY.—An illustrated article on store lighting. The author recommends the use of simple, inconspicuous fixtures, with units of an output well proportioned to the size of the room; the light sources should be high and of a relatively low intrinsic brilliancy and so arranged as to distribute a soft white light throughout the store. High-current enclosed arc lamps, fitted with a proper diffusing device, appear to form at present the best equipment for the general illumination of large dry goods and department stores. However, it may be that in the future the tungsten lamp will be more suitable in some places where previous to its development the arc lamp would have been selected. Just where the dividing line will ultimately lie still remains to be worked out.—*Gen. Elec. Rev.,* April.

### Generation and Transmission.

*Generating Station Improvements.*—An illustrated description of some original improvements in the Penn Station at Connellsville, Pa. They relate especially to the installation of a 3250-kw steam turbine and the general overhauling of the switchboard apparatus with installation of remote-control high-tension switches. Probably the most extraordinary feature in connection with the condensers installation is that the hot well pump is dispensed with. In its place a specially designed boiler feed pump is used to draw the water from the vacuum in the hot well and force it into the boilers. The tendency of water to be thrown out against and flow along the walls of a pipe in a steam line has been taken advantage of in the construction of a separator for the new turbine of somewhat novel form. It is a small horizontal drum placed on the end of the steam pipe on the engine room side of the boiler room wall. The pipe is brought to the diameter of the drum by a gradual enlargement or trumpet-shaped head on one end of the drum. The turbine supply pipe is taken off the top of the opposite end of the drum. A hand-hole is provided at the end for examining the interior of the drum. This separator is reported as giving unusually dry steam. The rotary converters in the station are

provided with a specially designed brush holder. Special vacuum pump-discharge valves and other devices have also been designed.—*St. R'y Jour.*, April 4.

*Electric Motors.*—C. F. Lawrence.—A discussion of the adaptability of different kinds of electric motors for different problems in driving machines and tools. At present there is a tendency toward both the group and the individual drive, it being generally agreed that the larger tools should be equipped with individual motors, such as machines that are intermittently driven, or where they are started and stopped to make ready or take off work. The direct-current series motor is ideal, when direct connected to a centrifugal pump. The direct-current shunt motor may be used to run all machines where a steady constant speed is required, such as small printing presses, ventilating fans, group driving and those machines which do not demand a heavy starting torque. The proper speed control is obtained by the insertion of resistance in the field coil circuits. The shunt-wound variable-speed motor is ideal for engine lathes, scrapers and all machines where it is necessary to run steadily at any one value of speed from no-load to full-load. The larger sizes of shunt-wound variable-speed motors are built with commutating poles. When a machine with a reciprocating motion, which reverses and tends to lower the speed, is to be electrically driven or when a machine is required to start with a heavy load, a compound-wound motor is necessary. Finally, the use of induction motors is discussed.—*Gen. Elec. Rev.*, April.

*Steam Turbines.*—S. L. Pearce.—A paper read before the Manchester Association of Engineers. The author deals briefly with some of the elementary principles of steam turbine design and with the development of the many types. A short description of the leading practical examples of the various types is then given, together with some data of their performances, and a comparison between turbine and reciprocating units.—Lond. *Elec.*, March 27.

## Traction.

*Railway Calculations.*—M. Mac Laren.—An article on the methods for calculating the performance of railway equipments under service conditions. Illustrations are given from tests on the N. Y., N. H. & H. R. R. which show a close agreement between predetermination and practice. It is usual in such calculations to simplify the work by substituting for the irregular profile of the road a uniform grade equal to the average grade between terminal points; if curves are not sufficiently severe to require slow-speed running, the effect of these is also averaged, and instead of figuring out each individual run for a train making frequent stops, the service is studied by a single typical run equal in length to the average distance between stops. While some discretion has to be used in applying this method, since it does not hold good over too wide limits, yet it gives accurate results with proper precautions, especially as to the running times, the heating, the energy consumption, etc. Diagrams are given showing a very good agreement between the calculated and the testing performance of a locomotive hauling a 296-ton train between New Rochelle and Larchmont. The remarkable steadiness of the line potential is pointed out. Even at the extreme end of the line, 18 miles from the generators, the line drop does not amount to 10 per cent at the time of heavy traffic. A diagram is given showing the performance of the locomotive when passing from the direct-current to the alternating-current system, only 20 seconds being required for the change. This change is ordinarily made when running at from 40 to 50 miles per hour.—*Elec. Jour.*, April.

*Car Equipment.*—A very long and fully illustrated description of the car equipment department of the Interborough Rapid Transit Company in New York City, its methods of car inspection, lubrication practice, car cleaning and labor payment. —*St. R'y Jour.*, April 4.—An account of the new method of maintaining the car equipment on the Chicago City Railway, which became necessary by the complete change from cable to electric traction, is given in *St. R'y Jour.*, April 11.

*Electrolytic Effects of Stray Currents.*—E. Nourtier.—A report on the electrolytic destruction of underground metal pipes by the stray currents from the rail return circuit of electric railways. The author thinks the only system which would completely overcome the trouble at present is that of a double overhead trolley wire. The conditions in Roubaix-Tourcoing, in France, are described. Within six years 60 cases of destruction of cast-iron water pipes by electrolysis occurred, while the thin tarred wrought-iron gas pipes were not damaged. The author thinks this is due to their higher resistance. On the other hand, telephone cables have been found badly damaged one year after they had been placed in the ground, the lead cover being completely eaten up so that serious service troubles were experienced and several kilometer length of cables had to be replaced.—*Jour. des Usines a. Gas*, 1907, Nos. 10, 11, 14, 15; *Jour. f. Gasbel.*, March 7.

*Tracks.*—H. L. Weber.—A discussion of the methods of proper construction and maintenance of tracks in electric railway service.—*St. R'y Jour.*, April 4.

## Installations, Systems and Appliances.

*Protective Devices.*—K. Kuhlmann.—A long illustrated paper read before the Berlin Electrical Society on modern protective devices against excessive currents in electric networks. The author recommends the use of circuit breakers with a time element even for low-voltage networks, instead of fuses. He then deals especially with systems in which the neutral point of the generator or transformer windings feeding the network is insulated from earth. It is shown by calculation as well as by experiments that in this case in extended cable networks of large capacity the earthing of one phase may cause very considerable excessive currents. These are pure charging currents. They are 90 time-degrees in advance of the phase of the e.m.f. If such an earth occurs there is danger of electric resonance with resulting excessive voltages. Every phase insulated from earth should, therefore, be protected by a circuit breaker. For smaller networks the danger is not so great, but in order to be independent of the size of the network it is recommended to apply the principle of continually earthing the neutral points of the generators or transformer stations. The resistor through which the neutral point is connected to earth should have a resistance of only a few ohms and should be so dimensioned that the current passing through it causes the potential of the neutral point to differ by not more than 10 per cent of the line voltage from the potential of the earth. The author then gives examples of networks in which protective

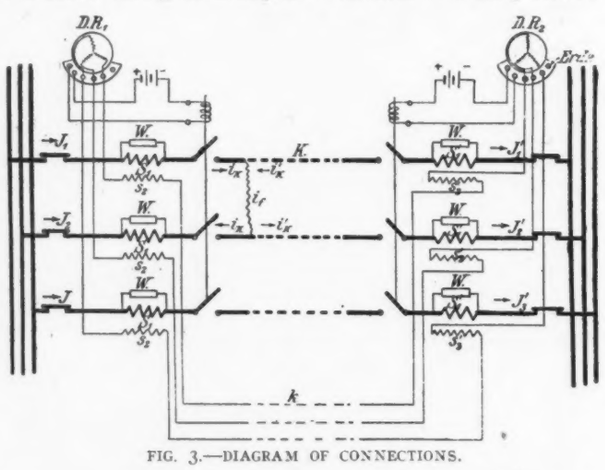


FIG. 3.—DIAGRAM OF CONNECTIONS.

devices are employed and emphasizes the difficulties arising in cable networks arranged in ring form. The differential protective system of Merz and Price, which has been developed by the Allgem. Elek. Ges. and is in practical use in various distribution systems in Germany and England, is shown in Fig. 3 as applied to a three-phase cable. $K$ is the main cable and $k$ is an auxiliary cable. At the terminals of $K$, series transformers $S_1$ and $S_1'$ are provided, the secondary windings $s_2 s_2'$ being con-

nected together by the auxilary cable $k$ in such a way that for equal time phases of $J_1$ and $J_1^1$, opposite e.m.f's are induced in same, their absolute values being equal for equal values of $J_1$ and $J_1^1$. The two diffenential relays $DR_1$ and $DR_2$ are inserted in the auxiliary circuit. As long as the cable $K$ is sound, currents equal in amplitude and phase pass through $S_1$ and $S_1^1$ (if we do not take into consideration the charging current of the main cable). The auxiliary cable $K$ and the two relays $DR_1$ and $DR_2$ are then without current, whatever may be the currents passing accidentally through the main cable; for instance, when there is a short circuit outside of the main cable. If, however, there occurs an earth or a short circuit within the piece of cable between the two series transformers, the currents $J_1$ and $J_1^1$ become different in phase or in amplitude, or both. The geometrical difference equals the fault current $i_f$. In the illustration the fault is shown as a short-circuit between two phases. The current $J_1^1$ differs now practically 180 deg. in time phase from $J_1$. There is also $J_2 = -J_1$ and $J_1^1 = -J_2^1$. The secondary voltages of the four series-transformers are, therefore, connected in series. The auxiliary cables and the relays carry current in two phases and disconnect the piece of cable within which the fault occurs, at both ends. The advantages of this system and various applications of it to many different cases are described.—*Elek. Zeit.*, March 19 and 26; April 2.

*Circuit Breakers.*—F. W. HARRIS.—The conclusion of his illustrated serial on circuit-interrupting devices. The author deals with the operation, installation and care of carbon-break circuit breakers. There is a need at present for the production of a circuit breaker at a reasonable price. In many industries, such as rolling mills and in general factory service, reliability even at a somewhat higher price is the main point. Improvements along this line are possible, but there is a probability that such designs will include magnetic blow-outs and omit carbon arcing tips. Oil circuit breakers also become more and more important as cost increases.—*Elec. Jour.*, April.

*Lightning Arresters.*—R. P. JACKSON.—The conclusion of his illustrated serial on the protection of electric circuits and apparatus from lightning and similar disturbances. The author gives directions for specifying lightning arresters and choke coils. He also gives instructions for installing multigap lightning arresters and shows the importance for grounds for lightning arresters. He finally deals with choke coils and safety spark-gaps.—*Elec. Jour.*, April.

*Three-Phase to Two-Phase Transformation.*—W. J. WOOLDRIDGE.—Troubles have been experienced in attempts to operate regular single-phase core-type transformers on three-phase primary, two-phase secondary circuits. This difficulty is due to the fact that in the transformation of power by means of the T-connection there arise certain peculiar current and voltage relations. The relation between the currents on the two sides of the primary winding of the main transformer make it absolutely necessary, if this distortion is to be avoided, to "balance" magnetically each half of the main winding on the legs. This is shown mathematically.—*Gen. Elec. Rev.*, April.

## Wires, Wiring and Conduits.

*Economical Limits of Voltage in Underground Cable Transmission.*—J. B. SPARKS.—Although it is possible to construct insulated cables for 50,000 volts or more, it may be more economical to employ cables of larger copper section and for lower pressures. The most economical pressure depends not only on the cost of the cable, but also on the cost of the transformers and the high-tension switchgear. Calculations are made for the special case of an annual transmission of 50,000,000 kilowatt-hours over a distance of 31 miles by three-phase alternating-current through two three-core insulated cables laid underground; power factor 0.9 and load factor 0.5; cost of energy at the generating end of the line 1 cent per kw-hour. Assuming that the load is equally divided between the two cables, the average load per cable is 2850 kilowatts. The calculation is made for four different working pressures; namely, 5000, 10,000, 20,000 and 40,000 volts between cores, and an annual loss of 5 per cent of the energy in all four cases is assumed. For 5000, 10,000, 20,000 and 40,000 volts the cost of copper in one cable will be $1,760,000, $440,000, $110,000 and $27,500 respectively (on the basis of $487 per ton of copper). In doubling the voltage from 5000 to 10,000 the saving in the cost of copper is $1,320,000, in doubling the voltage from 20,000 to 40,000, the saving is only $82,500. On the other hand, the increase in the extra cost of insulation due to the higher pressure is greatly increased. Fig. 4 gives the cost of three-

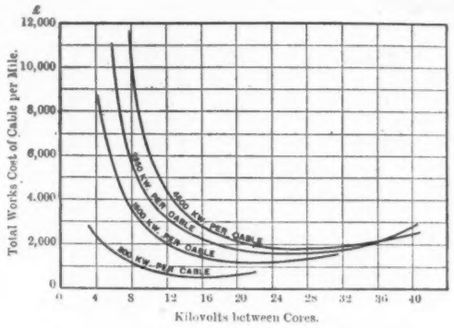



FIG. 4.—COST CURVES OF THREE-CORE CABLE.

core cable for transmitting different amounts of power per cable at different voltages between cores and with a loss of 0.61 per cent per mile. The curve marked 2850 kilowatts per cable relates to the figures mentioned above, while the three other curves correspond to cables of 4500, 1500 and 300 kilowatts average load. Thus, for example, a cable corresponding to any point on the 1500-kw curve would be capable of transmitting 1500 kilowatts to a distance of 31 miles with an annual loss of 5 per cent of the energy delivered or a line efficiency of 95.2 per cent. Along this same cable half the energy could be transmitted over double the resistance at the same efficiency. In the calculations on which these curves are based the costs of the lead coverings (lead at $100 per ton) and impregnated paper insulation ($200 to $300 per ton) are, of course, included. If the energy is less than 1 cent (0.5 penny) per kw-hour at the generating end of the line, then one can afford to waste

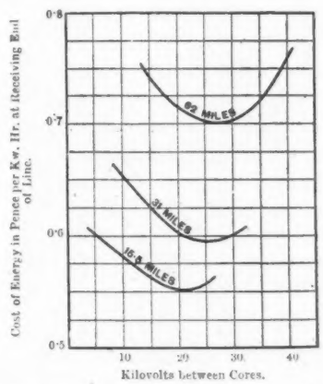



FIG. 5.—CURVES OF COST PER KW-HOUR AT RECEIVING END.

more in transmission, and the most economical efficiency will be lower or the loss per mile more. This means that a smaller section of copper will be required, and consequently the most economical voltage will be less than that corresponding to the higher line efficiency. In general, it will be rarely economical to employ a pressure higher than 25,000 volts between cores, since a higher pressure would be the most economical only in exceptional cases of large rates of energy transmitted per cable to very long distances. But for the sake of reliability it is advisable to keep down the rate of energy transmitted per cable and a very long-distance underground transmission is rarely practicable, since it evolves excessive capital cost. The effect of heavy capital cost of the line on the cost of the energy at the receiving end of the line is clearly shown in Fig. 5 in which curves are given of the cost per kw-hour at the receiving end of the line, expressed as a function of the e.m.f. in kilovolts

between cores and for distances of transmission of 15.5, 31 and 62 miles. For the 15.5 mile transmission, the minimum cost is obtained at an e.m.f. of 20,000 volts, for 31 miles at an e.m.f. of 25,000 volts, and for 62 miles at an e.m.f. of 27,000 volts. In all cases and at all voltages the cost per kw-hour, given in Fig. 5, is the minimum obtainable; that is, that corresponding to the most economical efficiency of the line. The influence of the "annual line efficiency" on the cost per kw-hour at the receiving end is shown graphically in the curves of Fig. 6.

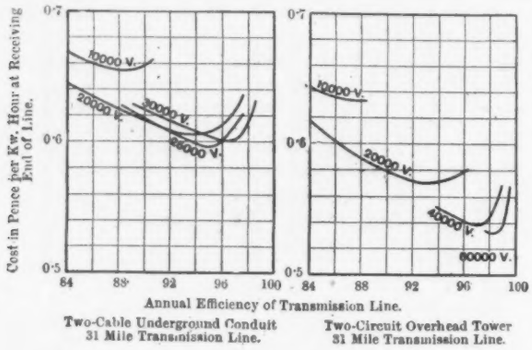



FIG. 6.—CURVES OF ANNUAL EFFICIENCY.

From these curves we find that the most economical line efficiency for the 31-mile transmission under consideration, is about 95 per cent for an e.m.f. of 25,000 volts. At a lower e.m.f.—for instance, 10,000 volts, which means a heavier capital cost—it is economical to waste more energy in transmission, and the efficiency for which the transmission cost is a minimum is about 89 per cent. The left-hand curves are for underground lines, the right-hand for overhead steel-tower lines. Comparing these curves, it is seen that whereas the most economical e.m.f. for an underground cable line, in the case considered, is about 25,000 volts, an e.m.f. of 60,000 volts or more will give the most economical results when an overhead steel-tower line is used. The capital cost in the latter case is also very much less, and the cost of transmission comes out at 0.064 cent (0.032 penny) per kw-hour at 60,000 volts against 0.190 cent (0.095 penny) per kw-hour for the 25,000-volt underground line. In neither case, however, has any allowance been made for the annual wayleaves or compensation charges, and these, of course, would be higher in the case of an overhead line passing through a populous district. The higher percentage charges for maintenance in the latter case were included.—Lond. *Elec. Eng'ing*, April 2.

### Wires and Wiring.

*Telephone and Power Wires on the Same Pole Line.*—An editorial on dangerous wire plant conditions, pointing out that it is "the too frequent practice of power companies of stringing their wires with little regard to the previous location of telephone wires." They seem to rely on the principle that if anything happens it will be the telephone wire that is damaged, leaving their own clear. It should be made a fundamental principle to run telephone lines under power lines and never over them.—*Am. Tel. Jour.*, April 11.

*Poles for Transmission Lines.*—L. Kallir.—The first part of a mathematical paper in which the author first calculates the stresses set up in an overhead transmission line when the line is intact and in the condition of maximum stress. The author then takes up the stresses set up in the poles when the line breaks somewhere. The paper is to be concluded.—*Elek. u. Masch.* (Vienna), March 22.

### Electrophysics and Magnetism.

*Formation of Concrete Matter from Atomic Origin.*—Lord Kelvin.—A paper which was written by Lord Kelvin some months before his death and in which he was interested down to the last days of his life. Coalition, due to gravitational attraction between materials given originally in small parts widely distributed through space, is probably the most ancient history of all the bodies in the universe. "Were the primordial atoms relatively at rest in the most ancient time, or were they moving with velocities, relative to fixed axes, through the center of inertia of the whole, sufficiently great to give any considerable contribution to the present kinetic energy of the universe? It is conceivable that all the atoms were relatively at rest in the most ancient time, and that the potential energy of gravitation may be in reality the ultimate created antecedent of all the motion, heat and light at present in the universe." The paper deals at length especially with the gradual evolution of the earth from its gaseous stage to liquefaction at the center and with the birth of the moon. With respect to the latter he holds Geo. Darwin's theory to be the most probable.—*Phil. Mag.*, April.

### Electrochemistry and Batteries.

*Aluminium.*—J. B. C. Kershaw.—An article on the condition of the aluminium industry in England, with an account of the boom early in 1907 and the collapse of the boom at the end of 1907, with the result that a reduction in price of 50 per cent on the 1906 values has marked the opening of 1908 in Europe. Aluminium has proven a successful substitute for copper in the manufacture of busbars, switchboard connections, lamp reflectors and similar smaller parts of electrical apparatus, and large orders for aluminium wire have been given by leading European electrical engineering firms. The smaller sizes of insulated wire required for bells and telephones are now being made from aluminium and the use of bare overhead aluminium conductors is also receiving further trial in Europe. Two new companies have been formed in England for the manufacture of aluminium.—Lond. *Elec.*, March 27.

### Units, Measurements and Instruments.

*Meter Testing.*—F. W. Prince.—An illustrated description of the very elaborate system of adjusting, calibrating, installing and treating watt-hour meters, used by the Hartford Electric Light Company. The equipment of the testing room, the standards used and the methods of installing the meters, keeping a very complete card record, and making regular tests are described. In an editorial note by H. W. Young on this article it is emphasized that a systematic method of handling the meter department should be a basic principle in every central station. With the recent development of the so-called "rotating" standard watt-hour meter, having several ampere and voltage connections, the question of expense is no longer serious even for smaller central stations, since the meters are reasonable in price and one standard will cover a large number of service meter ratings. Again the use of rotating standards materially reduces the time and expense of testing. Moreover, the load need not be kept constant and any desirable load, such as a lamp bank or a house load, may be used.—*Electric Jour.*, April.

*Resistor of High Resistance.*—G. W. Stewart.—A description of a convenient method of preparing a resistor of permanent high resistance by means of carbon and a transparent lacquer, called "Zapon." This lacquer consists of soluble cotton dissolved in certain mixed solvents, the chief ingredient of which is amyl acetate. When dry, there is left a film of pyroxyline which is elastic, is not subject to ordinary changes in temperature, does not evaporate, does not crack, and is a good insulator. If lamp black is mixed with this lacquer and sprayed with a brush upon an insulator a permanent and yet high resistance may be obtained. By a trial the author secured a variation in resistance from 3,000 to 3,000,000 ohms with a film approximately 3 mm long and 2 mm wide.—*Phys. Rev.*, April.

*Alternating-Current Instruments.*—An account of the extended discussion which followed Sumpner and Record's paper on alternating-current instruments with iron. Drysdale thought that their wattmeter is a devolopment of the induction wattmeter, but Sumpner did not agree with him.—Lond. *Elec.*, April 3.

### Telegraphy, Telephony and Signals.

*Telephone Conventions.*—An account of the recent Iowa convention in *Am. Tel. Jour.*, March 21, and *Tel'y*, April. Of papers presented at this convention that by A. C. Lindemuth,

entitled "A Larger View," is reprinted in *Am. Tel. Jour.*, March 21; those by W. B. Burke on telephone river crossings, original and maintenance cost; by W. S. Hart on prevention and defence of damage suits, and by A. Herr on cost of city exchange service in *Am. Tel. Jour.*, April 4.—An account of the recent Ohio convention in *Am. Tel. Jour.*, March 28, and *Tel'y*, April; the paper by G. R. Johnson on possibilities of the telephone business is reprinted in *Am. Tel. Jour.*, March 28, and *Tel'y*, April; that by J. B. Hoge on comparative telephone conditions in *Am. Tel. Jour.*, April 4, and *Tel'y*, April.—An account of the Michigan convention in *Am. Tel. Jour.*, April 4, and *Tel'y*, April. The paper by F. V. Newman on collections is reprinted in *Am. Tel. Jour.*, March 28; T. Bromley, Jr., on dangers of free service in *Am. Tel. Jour.*, April 4, and E. B. Fisher on a review of the telephone situation in *Am. Tel. Jour.*, April 11.

*Signals and Telephony in a Factory.*—K. KOEHLER.—An article discussing the best arrangement of the signal and telephone system of a factory so as to save as much as possible in the number of instruments and the amount of material used. For instance, by means of a common and properly chosen accumulator battery, it is possible to supply several plants with energy. Further, an electric standard clock, which is used to control a series of secondary clocks, may also be used as control apparatus for watchmen. The telephone system may also be simplified by proper selection of apparatus.—*Elek. Zeit.*, March 19.

*Telephone Cables.*—G. E. FURNAS.—While the installation of cables in a telephone plant reduces maintenance cost, troubles are also likely to occur. The author describes and illustrates various cases of damage which are likely to be done to telephone cables and the possibility of preventing them. The paper is to be concluded.—*Am. Tel. Jour.*, April 4.

*Lord Kelvin.*—A brief but interesting sketch, from the pen of W. Wien, of the chief tendencies in Lord Kelvin's work.—*Ann. d. Phys.*, 1908, No. 1.

## BOOK REVIEWS.

AUTOMATIC BLOCK SIGNALS. By Ralph Scott. New York: McGraw Publishing Company. 243 pages, 207 illustrations. Price, $2.50 net.

In the preface it is stated that this book is intended for the signal and railway engineer, the electrician and the layman. It deals with American practice in the installation and maintenance of signals electrically controlled and operated by electric or other power, with descriptions of the accessories now regarded as standard. The author has selected a descriptive method of presentation, and the book consists largely of circuit diagrams and explanations thereof. However, the relative advantages of different schemes, as tried and either abandoned or further developed, are discussed briefly. The book furnishes much accurate information concerning modern block-signal systems, logically arranged and expressed in simple language.

THE MECHANICAL DESIGN AND CONSTRUCTION OF COMMUTATORS. By R. Livingstone. New York: D. Van Nostrand Company. 93 pages; 62 illustrations. Price, $2.50 net.

A careful examination of this little book will convince one that even in the seemingly simple problem of selecting the proper dimensions for a commutator complicated methods can be employed, and in certain instances such methods are desirable. The author has attempted to make the treatment absolutely accurate within the limits between which commutators built by the same workmen and assembled in the same shop are found to vary in practice. He gives a discussion in detail of the stresses caused by centrifugal force, initial tension, and expansion due to heating in V-ring and shrink-ring commutators, and shows how these two types of commutators should be assembled. Descriptions of various other types of construction are also given.

In the preface the author states that in dealing with certain stresses many short cuts have been avoided purposely. It seems to the reviewer that the only important defect possessed by the book lies in the omission of these "short cuts" and the substitution therefor of methods which give no better results while being far more complicated. For example, the appendix contains an elaborate proof of the location of the center of gravity of a triangle involving the use of calculus, when any one even slightly familiar with geometry can locate the center of gravity with the utmost ease, and any designer of commutators would willingly have accepted a mere statement of its position without proof. However, the error of unnecessary refinement is on the side of safety. The work will doubtless be found of assistance to designers of electrical machinery.

## Mercury-Vapor Lamps in Silk Mills.

There are few, if any, industries requiring so great care in the selection of good quality and proper distribution of light as that of silk. If it were possible to operate the machinery of the average silk mill wholly by daylight illumination, it is hardly probable such mills would ever be equipped with any sort of artificial lighting apparatus. The waste and loss of time due to inadequate illumination, and the further loss due to the decreasing efficacy of many operators in the more exacting operations, due to eye strain and its usual accompaniment of nervous troubles, all combine to form a group of troubles the elimination of which cannot fail to interest any silk manufacturer in the improvement of artificial illumination.

An early application of mercury-vapor lamps was made in illuminating silk throwing plants. The distribution of light obtained may be judged from Fig. 1, giving a view of the illumination by Cooper Hewitt lamps of spinning machines in the mill of the H. H. Seaton Company, Passaic, N. J., with absolutely no daylight; the photograph was taken late in the evening to avoid any possibility of the presence of daylight. The operators state that they can see every thread upon the machine from a position at the end of the machine. There is an almost entire absence of shadow in any part of the room, and the light from the mercury-vapor lamp clarifies or magnifies the thread so much that the twist is made extremely plain.

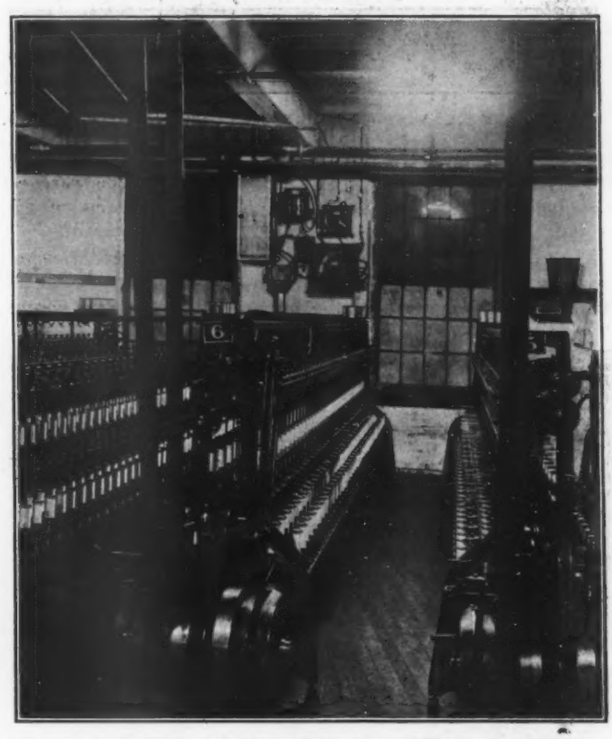


FIG. 1.—SILK-SPINNING MACHINES ILLUMINATED BY MERCURY-VAPOR LAMPS.

This quality of seemingly magnifying the thread has proved of great advantage to the inspection department by the much

advantages are obtained. The mechanism consists of the spring-operated poppet valve, a stationary cage and bonnet in which it is housed, and a mixing or regulating valve sleeve that reciprocates within the cage and rotates on the inlet valve stem. The mechanism has, in fact, three distinct movements: first, the vertical movement of the valve transmitted from the eccentric; second, the vertical movement of the regulating sleeve, which is carried with the valve stem; and third, the rotation of this sleeve on the valve stem, as actuated by the governor mechanism. The regulating sleeve is a cylinder which has two sets of ports, one for gas and the other for air, which register with corresponding openings within the valve cage that connect with gas and air supplies; the action of the mechanism is such that, when the valve is closed, this sleeve is raised and closes both ports, but as the valve opens, it drops and uncovers the ports, the amount of the opening in either set of ports depending upon the angular position of the sleeve in its rotation about the valve stem as controlled by the governor. The result of this arrangement is that the gas and air are mixed directly at the point of entrance to the cylinder and only as needed by the engine, which avoids large quantities of idle mixed gases in intake connections and results in giving the governor absolute control over the engine. Incidentally a very small amount of mixed gas is involved in case of a back fire. An additional advantage is to be noted in that the constant movement of the valve mechanism, which results in this design, prevents any possibility of the governor valve sticking when the engine is run on constant loads for long periods. Furthermore, as the mixture at each end of each cylinder is independently controlled by the governor, a closer speed regulation has been found possible, the angular variation of the flywheel velocity being such that no difficulty has been experienced in the operation of alternating-current generators of standard frequencies, in parallel. The standard flywheels furnished on these engines are of such proportions that with one cylinder out of commission, the angular variation will be within the limits prescribed for steam practice. Thus, with all four cylinders in operation, the angular variation is less than in standard reciprocating steam-engine practice.

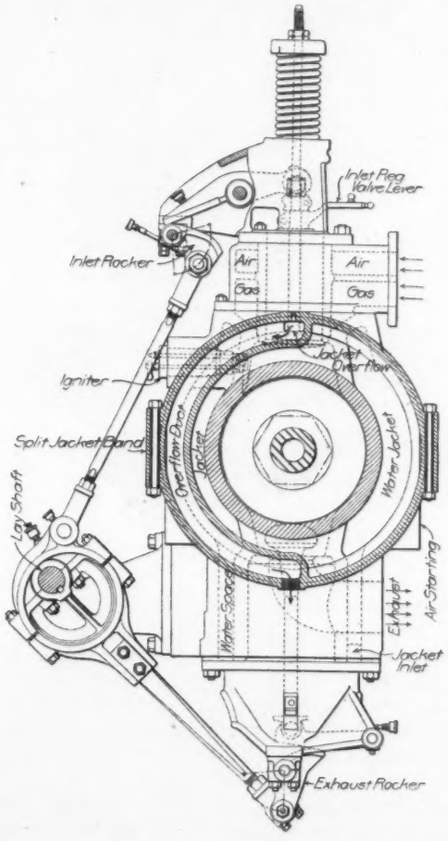



FIG. 2.—DETAILS OF CYLINDER AND VALVE GEAR.

The governor, which is of the centrifugal type, operates a small pilot valve which admits oil under pressure to either end of a small cylinder that forms a part of the governor mechanism, which cylinder actuates the mixing valves of the main cylinder through long-reach rods.

For the ignition, the make-and-break system has been adopted, as best suited for large engines and poor gas. The whole ignition system is insulated from the engine, so that

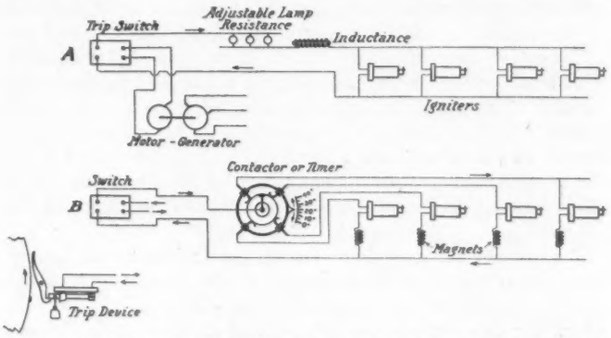



FIG. 3.—DIAGRAM OF WIRING PLANS. A, FOR MECHANICAL IGNITERS. B, FOR MAGNETIC IGNITERS.

"grounds" must occur at two sides of the system simultaneously to render it inoperative. The igniter mechanism is mechanically driven. It is provided with a magnetic indicator to show at all times the condition of the various igniter circuits. The indicators consist of small "sounders" inserted in the inductance coil circuit to each plug, having visible moving armatures, so that the failure of any igniter is indicated at once to the attendants by the failure of the sounder in its circuit to operate regularly. The ignition gear is provided with a mechanical device for advancing or retarding the spark to meet the requirements of gases of various richness. This device consists of a sleeve having internal spiral grooves engaging pins on the igniter lay shaft. This sleeve is free to revolve with the igniter lay shaft, but it can be moved backward and forward by a graduated hand wheel, so that the relative positions of the main and lay shafts may be changed.

## Mercury Arc Rectifier in Moving-Picture Shows.

One of the most recent applications for which mercury arc rectifiers have proved pre-eminently successful is in the operation of arc lamps for moving picture shows. The arc lamps which are used as the light source for moving pictures are usually required from 35 to 60 amp of alternating current and about 25 to 30 amp of direct current. Up to a few years ago they were operated in series with resistances on 115 or 220 volts to bring the lamps to the proper arc voltages. This makes a very wasteful consumption of energy, which is considerably more for the alternating current lamps on account of the higher amperage necessary for producing a light of sufficient intensity.

Apparatus for efficiently cutting down the voltage on the direct-current lamps must of necessity be a much more expensive and elaborate outfit than a device designed for a similar purpose for alternating current. The initial cost of the former has prevented its general adoption except for locations where only 500-volt direct current is available, as in summer resorts operated by street railway interests. On the other hand, the problem for overcoming the waste of energy in rheostats on alternating-current lamps has been at least superficially overcome by use of compensators, choke coils and similar devices. While these devices are less wasteful than rheostats, they possess a very low power factor, which makes them undesirable from a central station standpoint. It is stated that some of the large central stations are ordering them removed from their lines, and at least one central station has made a different

greater amount of goods inspected by the light than was possible by daylight, with an added advantage of absolute uniformity of quality and quantity of illumination.

Fig. 2 shows a photograph of the ribbon looms in the mill of the Spiers Silk Company, Paterson, N. J., where every

FIG. 2.—RIBBON LOOMS ILLUMINATED BY MERCURY-VAPOR LAMPS.

operation of production is successfully conducted under the light of Cooper Hewitt lamps. The processes include warping and quill-winding as well as the weaving of ribbons of all colors.

The detail view of the looms is especially successful in showing the distribution of light on the ribbons and back of the heddles, continuing through the harness and enabling the weaver to pick up and follow a broken thread in the warp with the least possible delay.

The weaver operating broad silk looms finds the lamp of especial advantage because it can be so placed that great volumes of light are thrown, not only on the woven goods, but directly into the loom harness.

The clarifying quality of the light with an absence of any black shadows is of especial advantage here.

With the cheap production of great volumes of light broadly diffused from a high point, due care being exercised in the location of lamps with reference to the points most needing light, a successful illumination of warping machines and Jacquard looms would be expected and has been accomplished with most gratifying results.

A brief statement regarding cost of energy for these lamps is of interest at this point. The type of Cooper Hewitt lamp having an approximate rating of 700 candle-power, operating upon 110 volts, consumes 3.5 amperes or 385 watts. At 10 cents per kw-hour the cost is $.0385 per hour. The average 16-cp incandescent lamp consumes 60 watts, costing 0.6 of a cent per hour.

In a throwing plant formerly using from 200 to 250 16-cp incandescent lamps, 20 300-cp mercury-vapor lamps were placed about two years ago.

| | Light. | Power. |
|---|---|---|
| 200 16-cp incandescents | = 3200 cp | 12 kw |
| 20 type H Hewitts | = 6000 cp | 3.85 kw |
| At 10c. per kw-hour the cost of | | |
| 3200 cp incandescent | = $1.20 per hour | |
| 6000 cp Vapor | = .385 " " | |
| Saving | = $ .815 " " | |

Thus an illumination equivalent to twice the candle-power of the old illumination at one-third the cost.

## Gas Engine for Driving Generator in Steel Mill.

The Carnegie Steel Company recently installed in the generating station of the Edgar Thomson Steel Works, at Bessemer, Pa., a 2000-kw direct-current generator driven at 84 r.p.m. by twin-tandem horizontal engines operating from blast-furnace gas, which possess many features of interest. The most striking details of the engines, which were built by the Westinghouse Machine Company, are the inlet-valve mechanism. A single eccentric operates both the inlet and outlet valves, the electromagnetic igniters and the automatic starting arrangements.

There are four 42 in. by 54 in. double-acting cylinders, each having at least two separate igniter plugs. Starting is accomplished by an automatic compressed-air system, controlled by a single valve, which continues in operation until all igniters are working properly.

The inlet valves are of a novel design, which combines the functions of inlet, mixing and governor valves in a single mechanism by means of which it is claimed that a number of

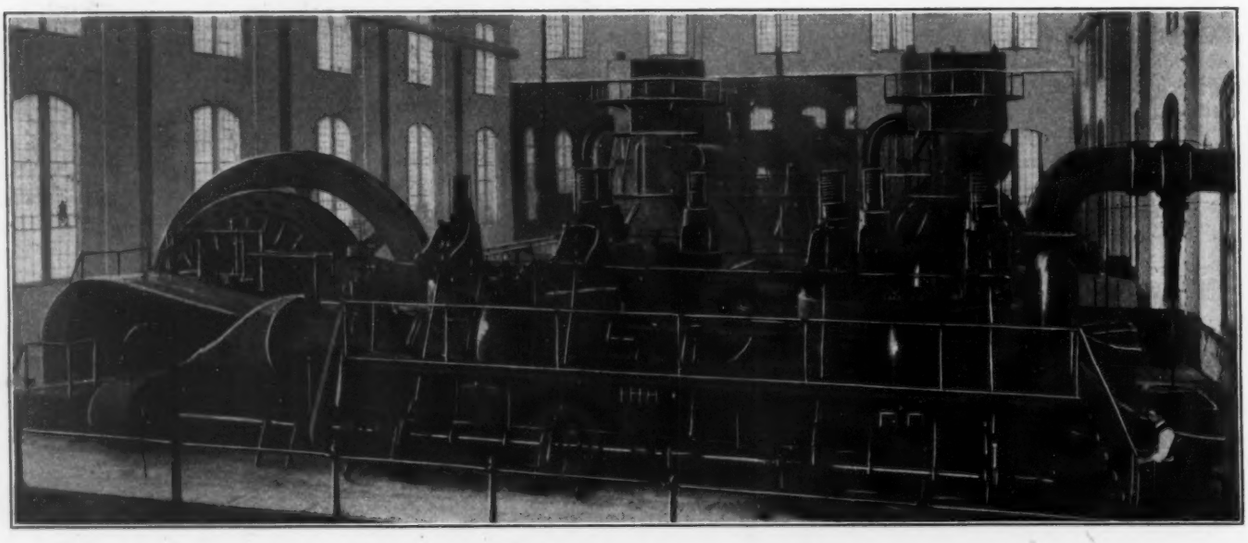


FIG. 1.—BLAST-FURNACE GAS ENGINE DIRECT-CONNECTED TO GENERATOR AT BESSEMER.

tection of induction motors in mills and factories, as it can be installed on any convenient post or wall. One of the standard forms is a double-throw switch combining the features of an auto-starter with those of a circuit-breaker. This switch is automatic on the running side and also on the starting side

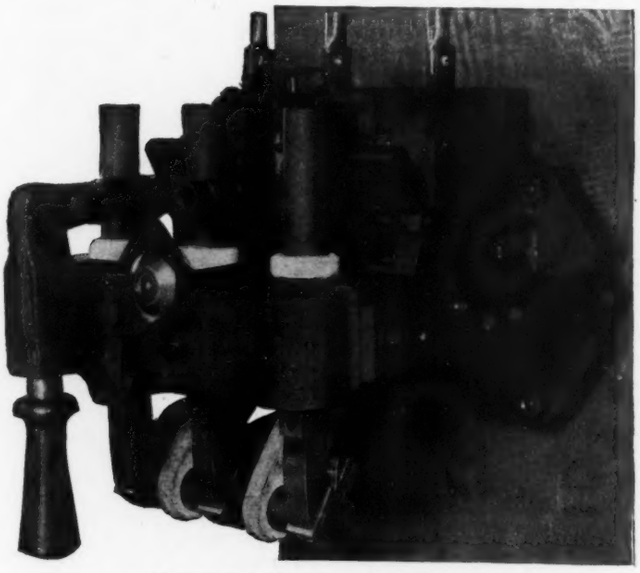


FIG. 1.—CIRCUIT-BREAKER FOR WALL OR POST MOUNTING.

under certain overload conditions. The auto-transformers used in connection with it are mounted on the supporting frame with the circuit-breaker, the layout being thus entirely self-contained and easy to install. Both transformer and switch parts are enclosed in a heavy sheet-metal case, which serves the double purpose of preventing the operator or workmen from coming in contact with the live parts and as a protection against dirt and dust. Three taps are provided on each transformer, so that the voltage on the starting side can be made 50-65 or 80 per cent of the full line voltage. When the switch is thrown over to the running side, the transformers are cut out of cir-

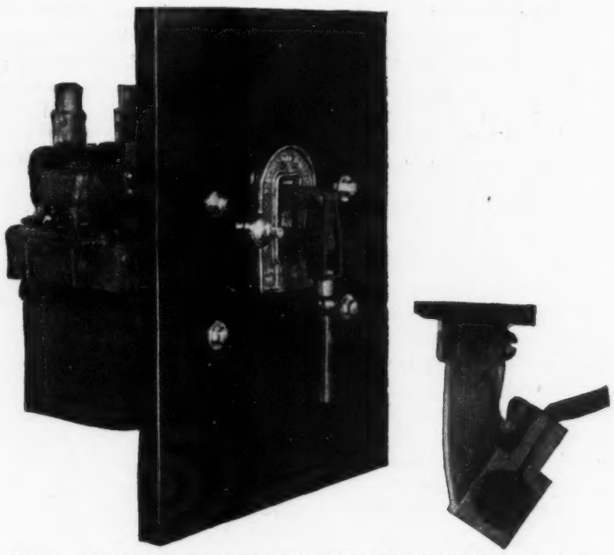


FIG. 2.—CIRCUIT-BREAKER FOR SWITCHBOARD MOUNTING



FIG. 3.—CIRCUIT-BREAKER CONTACT.

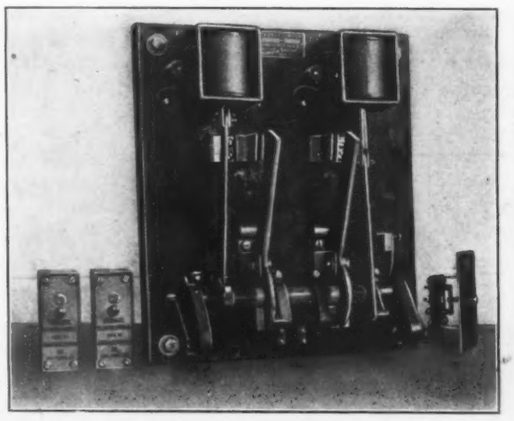
cuit. The device thus combines the features of an oil-immersed auto-starter with those of an overload and low-voltage circuit-breaker.

The contacts are of the laminated type, protected by auxiliary or arcing contacts which can be easily replaced, should they become burnt away in the course of time. A powerful toggle action is secured at the final closing movement, which brings the movable contacts tightly against the laminated brushes and produces the perfect self-cleaning contact shown in Fig. 3. In the construction of the operating mechanism the use of small, delicate parts has been avoided and the levers and toggles are amply large and strong. All bearings are of dissimilar metals so that they cannot rust tight. The construction is rugged throughout and made to withstand hard usage.

For single-phase circuits the circuit-breaker is provided with one overload coil; for two- and three-phase circuits, it is furnished with an overload coil in one or two phases, as desired. Low-voltage release is furnished either alone or in combination with a single- or double-overload coil. The latter construction is used in the wall mounting form shown in Fig. 2. Both overload and low-voltage release are arranged so that the circuit-breaker will trip should the operator attempt to close it while low-voltage or overload conditions exist.

## Double-Magnet, Quick-Break Switch for Remote Control.

The accompanying illustration shows a three-quarter view of a double-magnet, quick-break switch brought out by the Automatic Switch Company of New York City to meet the constantly growing requirement for heavy ampere-capacity, quick-break switches for remote control, with magnet circuit de-energized after the throw of the switch. In the switch shown the normal pull of the solenoid is increased sufficiently to insure a positive opening of the blades by storing the energy



DOUBLE-MAGNET QUICK-BREAK SWITCH.

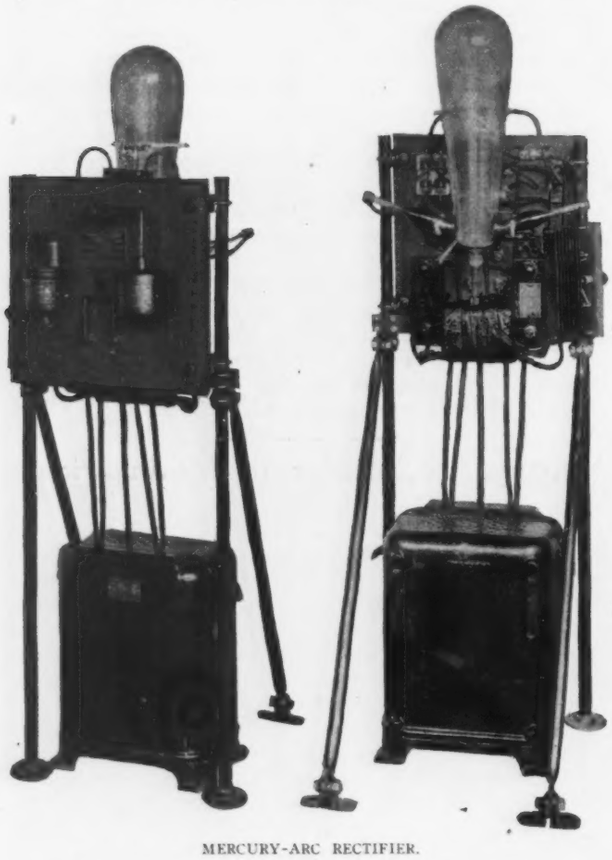
of the pull in the momentum of the weight and in the coil spring shown on each side of the weights. The result is that the quick blow effect in striking the blades in opening insures positive operation under all conditions. This form of switch can easily be made for various ampere capacities and number of poles by changing of the blades and contacts only, the other parts remaining the same for all sizes. It is shown mounted on a slate slab 1⅛ in. thick by 14 in. wide by 16 in. high, and is intended to go in a box at least 7 in. deep.

The controlling buttons shown are of the single-pole type, so that the switch can be opened only from the control point, it being necessary to place another button on the switchboard to close it. Another form of switch has two buttons in the same box, thus giving complete control of the switch both "on" and "off" from any number of buttons. These switches are supplied for alternating- or direct-current circuits where the number of operations per day is not sufficient to warrant the use of carbon and copper contacts, and they may be used successfully in connection with time clocks for cutting off the supply of electricity in a certain district at a predetermined time, cutting in again the next day. As the magnet circuits are broken on this switch, no special provision is required in the buttons or controlling points to offset the effect of arcing, since no arcing occurs.

service rate for establishments using these devices. The direct-current arc lamp is a very much better source of light for moving pictures than the alternating-current arc, principally on account of the greater steadiness of its light, and the considerably lower watt consumption necessary to produce a sufficiently brilliant light.

The General Electric Company has recently designed and sold a number of rectifiers adapted especially for use in supplying direct current to moving picture arcs, where only alternating current is available. The back and front views of one of these rectifier sets are shown herewith. This rectifier set is designed for operation on a 220-volt alternating-current circuit, and has a continuous capacity of 30 amp direct current, and a capacity of 40 amps or slightly more during the starting of the arc. The rectifier is designed to deliver a direct-current voltage equal to that required across the arc, or from 45 to 50 volts. A reactance in series with the alternating-current supply serves to steady and regulate the current taken by the arc lamp. This eliminates the necessity of having a wasteful resistance in the arc circuit.

The rectifier set is similar in some particulars to the battery charging rectifier now in common use. The regulating features and other parts necessary for battery charging, but not required for this service, are omitted, and the rectifier equipment reduced to its simplest form. The apparatus may be installed



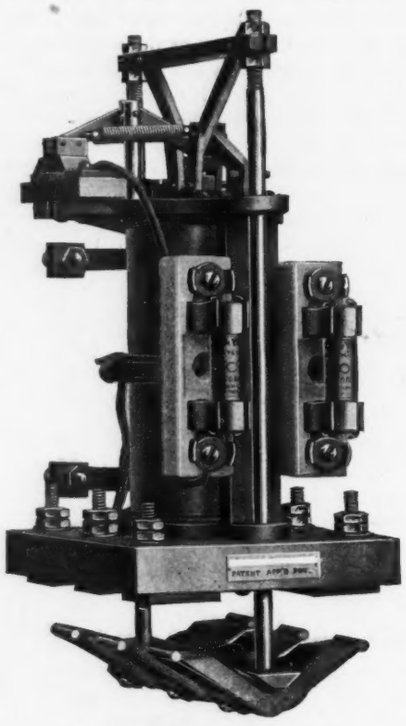
MERCURY-ARC RECTIFIER.

at a distance from the picture-machine operator, for instance in the basement, and may be started by the operator without leaving his booth.

The only operation necessary to start the rectifier, after the supply switch is closed, is to touch the two carbons of the arc lamp together, hold them so for a second or two, and on separating the carbons a direct-current arc will be drawn. The closing of the carbons allows the current to flow through a coil on the panel, which tilts the tube once or twice and causes it to start. The rectifier not only enables a direct-current arc with its far better light to be used, but the cost of the operation is much less than with either alternating or direct current with inductances or resistances in series with the arc.

## Remote-Control Switch.

The accompanying illustration shows a remote-control switch recently placed on the market by the Central Electric Company, Chicago, Ill. The switch is equipped with two coils acting upon a core attached to a toggle mechanism carrying the main brush contacts. When the circuit through the upper coil is completed the entire mechanism is drawn up until the switch toggle locks and firmly draws the laminative copper brushes against the stationary main contact. By completing the circuit



REMOTE-CONTROL SWITCH OPEN.

through the lower coil, the heavy core is drown down, "breaking" the toggle, and the switch falls open by gravity.

The control switch is of "momentary-contact" type, so arranged that when the button is pressed a "snap" contact is made and a "snap" break is obtained when the button is released. The two buttons cannot be pressed together. As the switch fits a standard wall box and uses a standard gang plate, it can readily be installed and can be used either with a push button or a key. The switch is applicable to either direct or alternating current, is made for all e.m.fs. up to 250 volts and for current ratings up to 2500 amperes. The switches are very compact, the 50-ampere size occupying a space approximately 12 in. x 6 in. x 5 in.

## Circuit-Breakers for Low-Tension Alternating-Current Circuits.

Oil-break circuit-breakers are now largely used for the protection of alternating-current circuits of 600 volts or less, as the same qualities which have brought the oil-break switch into almost universal use for interrupting high-tension circuits, have recommended it to engineers for low-tension work. A new type of circuit-breaker, manufactured by the Hartman Circuit Breaker Company, of Mansfield, Ohio, shown in the accompanying illustrations, has been designed especially with a view of furnishing a low-priced protective device for alternating-current circuits of 600 volts or less. They are made for capacities up to 600 amperes, for either switchboard or wall mounting, single- and double-throw, plain overload release or combined overload and low-voltage release. The wall mounting form, shown in Fig. 2, is especially well adapted for the pro-

## Sewage Pumping Stations at Dayton, Ohio.

The city of Dayton lies in a valley surrounded by hills whose slopes drain very rapidly. At this point, several streams unite to form the Great Miami River. This stream in summer is of insignificant proportions, but in late winter and early spring, after a sudden rain or melting snow, it rises in a few hours to the proportions of a great river. To protect the city from inundation, levees are maintained, but a rise in the river cuts off the sewers and it is necessary to close the gates at the outfalls to prevent the river backing up into the streets and houses. At such times it is necessary to raise the sewage and discharge above the flood level. After careful investigation and some costly and unfortunate experiments with steam pumps and pneumatic ejectors, which either required too much attention or were too expensive or uncertain in operation, the city of Dayton decided to install automatic electric pumps and awarded the contracts to the Dayton Hydraulic Machinery Company, builders of the well-known "Brooks" and "Dayton" centrifugal pumps.

When electric motors were decided upon, central station service was accepted as the most satisfactory, since power can be obtained on a moment's notice at any time, night or day, there is an entire elimination of steam boiler and engine troubles, and the maintenance and operating charges are a minimum.

Three stations have so far been constructed in various sections of the city. The first is equipped with two vertical 2500-gal. Brooks submerged centrifugals, geared to 20-hp, horizontal,

VIEW OF AUTOMATIC ELECTRIC SEWAGE PUMPS AND STARTER.

three-phase, 60-cycle Westinghouse motors. The motors are started and stopped by standard oil-switch compensators which are operated by hydraulic pistons controlled by float switches designed and built by the Dayton Hydraulic Machinery Company under its patents. The lift is variable, averaging about 20 ft. The discharge is through a check valve at a point below extreme high water. The operation of these pumps is entirely automatic, it being only necessary to inspect them occasionally and keep the oil receptacles filled. Upon notice of a rise in the river, the gates are closed and the current turned on, after which the pumps cut in and cut out automatically with the rise or fall of the sewage in the pits.

The second station, at Longworth Street, has three units, and the third station, at Lehman Street, two, each consisting of a double-suction vertical submerged 4500-gal. Brooks centrifugal, direct-connected to a 40-hp, vertical type, three-phase, 60-cycle, 2080-volt Westinghouse motor.

The starting apparatus at these last two stations consists of floats which operate the valves on a hydraulic piston, using water under pressure from the city mains. On starting, this piston raises the lever on a Westinghouse auto-starter to the starting position, at the same time rotating an arm carrying a heavy counterweight which, by the time the motors have picked up speed, falls, and by means of a pawl, drops the lever to the running position. On stopping, the reverse motion given the counterweights moves the lift to the cut-out position. The operation of this apparatus is extremely satisfactory and the motors cut in and cut out automatically with great regularity and smoothness. During a heavy rain, when the river was quite high, one pump was sufficient to take care of the flow in the sewers at the Lehman Street station when running three minutes out of each ten, being idle the remaining seven minutes.

## Additions to D., L. & W. Shop and Mine Electrical Equipment.

During the past year the Delaware, Lackawanna & Western Railroad has made extensive additions to its electrical shop and mine equipment in the vicinity of Scranton, Pa.

At the Hampton power plant one 2000-kw Allis-Chalmers turbo-alternator has been installed, with barometric condenser and dry-vacuum air-pump. The building has been increased in size to accommodate another unit of the same size. A new switchboard and cellular oil-switches have also been installed in this plant.

The boiler plant at this same location, which was normally rated at 4500 horse-power, has been increased in capacity by 3800 horse-power, the new installation being in six units of the two-drum Stirling boilers.

Four substation equipments have been installed, consisting of 350-kw, three-phase, 60-cycle transformers and 300-kw, 275-volt rotary converters with necessary switchboard apparatus. One new substation, consisting of two 350-kw, three-phase, 60-cycle transformers and two 300-kw, 275-volt rotary converters, with necessary switchboard apparatus, has been installed. This substation is inside of a mine; the transmission line, 4150 volts, 60 cycles, is brought through a varnished cambric, lead-covered, iron-armored cable suspended in a borehole from the surface 700 ft. deep.

Twenty-two 6½-ton electric locomotives, equipped with a cable-reel device for running up into chambers, have been installed; also one 10-ton electric locomotive, without reel.

The following bronze centrifugal pumps have been installed at mines: One 500-gal., two-stage, 125-ft. head, driven by a 30-hp, 440-volt, 900-r.p.m. induction motor; two 500-gal., two-stage, 183-ft. head, driven by 40-hp, 2200-volt, 1200-r.p.m. induction motors; two 800-gal., four-stage, for 330-ft. head, one being driven by a 100-hp, 2200-volt induction motor at 1200 r.p.m., and the other by a 75-kw synchronous motor, having the same speed and voltage; three 450-gal., single-stage pumps, driven by 30-hp, 440-volt, 1800-r.p.m. induction motors; one 1200-gal., two-stage, 160-ft. head, driven by a 75-kw, 3800-volt, 1200-r.p.m. synchronous motor; two 150-gal., two-stage pumps, driven by 10-hp. 250-volt direct-current motors; two 250-gal., 500-ft. head plunger pumps, driven by 50-hp, 440-volt induction motors; eight 100-gal. triplex pumps, mounted on trucks for sinking purposes, four being driven by 10-hp, 440-volt induction motors and four by 10-hp, 250-volt direct-current motors.

There have also been installed one hoist, equipped with two 80-hp, 500-volt direct-current motors; four hoists equipped with 25-hp, 250-volt direct-current motors for sinking purposes; two hoists equipped with 112-hp, 440-volt induction motors, and one hoist equipped with a 200-hp, 440-volt induction motor. The hoists equipped with induction motors are fed through three-phase, 60-cycle transformers of 100- and 200-kw capacities, respectively, for the 112- and 200-hp motors. The primary connections of the transformers can be made for either 2400 volts or 4150 volts.

A rail-bond testing outfit has recently been installed, which is mounted on a flat car and used to locate bad bonds in the rails on the roads over which electric locomotives operate.

# Industrial and Commercial News

## Commercial Intelligence.

THE WEEK IN TRADE.—While there were numerous developments during the last week which tended to increase the hopeful spirit in the commercial world, there was but little improvement noted in distributive trade and industry, and on the whole trade was quiet. Fine crop reports, a stronger securities market and very easy money, all combined to create a more confident feeling than for some time past. Wheat prices have advanced sharply on statistical grounds, also the new crop to a lesser extent, notwithstanding excellent crop reports. April railway earnings show a decrease of from 15 to 16 per cent from the values for the same period in 1907, as compared with a loss in March of 14 per cent. Accumulations of money at all the centers are reported, and there is a plethora of funds seeking investment. Collections continue behindhand, and extensions are constantly asked. The metal trades are reported at a low ebb. Pig iron is depressed, and price concessions rule, the independents seeming to get what little business is to be had. The success of the Pennsylvania Railroad in placing its bond issue means a great deal to the iron and steel trades, providing other roads meet with equal success. Demand for structural material continues fair. Failures for the last week, ended April 23, as reported by *Bradstreet's*, were 254, against 261 in the preceding week, 157 in the corresponding week in 1907, 177 in 1906, 193 in 1905, and 197 in 1904. Very little activity is to be reported among the electrical interests in New York City. No large orders are reported, and even export business, which has heretofore been excellent, has sagged, though several important foreign projects will be announced shortly in these columns. Reports from the various committees which have in charge the rehabilitation of the Westinghouse Electric & Manufacturing Company indicate that the plans are making encouraging progress.

CAPITAL CITY POWER COMPANY.—Work has been begun on the Capital City Power Company's plant, the third and largest development of the United Missouri River Power Company, of Helena, Mont. This new development, which is to meet the growing business of the company, will be situated on the Missouri River about 25 miles below the Helena Power Company's generating station, and about 33 miles from the city of Helena, where the topographical condition is such as to enable the construction of a hydro-electric plant on the most economical basis. At this point, in the opinion of the company's engineers, there is available 300,000 hp under a head of 110 ft. The plans of the company include the erection of a dam and power house, and the initial installment of hydraulic and electrical equipment will be sufficient to generate 20,000 hp. High-potential transmission lines will be constructed from the station to a point 18 miles distant, where a connection will be made with the high-tension lines of the Helena Power Transmission Company, from which point the energy is delivered to the constantly increasing consuming centers of Butte and Anaconda. Reports from Helena state that the new dam will be the second largest in the world, and in addition to furnishing hydro-electric energy, will irrigate thousands of square miles in that section of the country. By July 1 more than 500 men will be at work on the new dam. The size of the enterprise is shown by the fact that 125,000 barrels of cement will be used, which, if loaded on cars, would compose a train nine miles long. One thousand tons of steel will be required for the construction work. The present developments of the United Missouri River Power Company consist of the first water-power plant, or the original development on the Missouri at Canyon Ferry, about 17 miles northeast of Helena, which has a rating of 9250 hp, and the second development (Helena Power Transmission Company) at Hauser Lake on the Missouri River about 16 miles below the Canyon Ferry plant, which has a total rating of 18,650 hp. With the operation of three hydro-electric stations the company will have practically a monopoly of the electric business in the mining region penetrated by its lines. Among the directors of the United Missouri Power Company are S. T. Hauser, president; Senator William A. Clark; F. P. Addicks and B. B. Thayer. The development of the Capital City Power Company is financed by an issue of $1,500,000, 30-year, first mortgage gold bonds, put forth by the banking firm of A. B. Leach & Company, of New York.

THE WIRE INSPECTION BUREAU has recently taken steps to enlarge its scope and its methods of operation and plans for increasing its efficiency. In addition to its factory inspection service, it has inaugurated a system of field inspection, through its own inspectors, so that frequently coils of wire are now purchased from jobbers throughout the country and subjected to rigorous tests as to material and insulation. This service is limited to National Electrical Code wires and all coils conforming to this standard bear the certificate of the bureau in the form of a stamp. The following manufacturers avail themselves of the service of the bureau: Atlantic Insulated Wire & Cable Company; American Electrical Works; American Steel & Wire Company; Bishop Gutta Percha Company; Boston Insulated Wire & Cable Company; Bourn Rubber Company; W. R. Brixey Company; Collyer Insulated Wire Company; Consumers' Rubber Company; Crescent Insulated Wire & Cable Company; Detroit Insulated Wire Company; General Electric Company; Hazard Manufacturing Company; Home Rubber Company; Habirshaw Wire Company; Indiana Rubber & Insulated Wire Company; Marion Insulated Wire Company; Alfred F. Moore; New York Insulated Wire Company; National India Rubber Company; Phillips Insulated Wire Company; John A. Roebblings' Sons Company; Safety Insulated Wire & Cable Company; Simplex Electric Company; Standard Underground Cable Company; Waterbury Company.

WESTINGHOUSE TURBO-GENERATORS FOR THE FAR EAST.—Ten machines, aggregating 25,000 horse-power, are included in a large shipment of Westinghouse turbo-electric power equipment from East Pittsburg to the Far East. Most of these machines will go to Japan for the equipment of railway, lighting and manufacturing plants. One of the first machines to be put in service will be a 1500-kw turbine unit for Manila, to be installed in a railway power house with four other machines of like construction put into service several years ago. The Manila railway system was engineered and constructed by J. G. White & Company. Three machines of 5000 hp each go to the Osaka Electric Company, Osaka, Japan, for its new station, which will be one of the largest power stations in Japanese territory and will initially contain 15,000 kilowatts in five units, the remainder of which will follow as fast as they can be built and tested. The Osaka installation is under direct charge of Messrs. Takata & Company, of New York and Tokio. For installations in process of erection at the Imperial Steel Works of the Japanese government and the ship yards of the Hakkaido Tanko Steamship Company there are four 500-kw turbo units, two of which will comprise an initial installation in each of these plants.

INDUCTION MOTORS FOR BREWERY.—The Pabst Brewing Company, Milwaukee, recently placed contracts for a line of 25-cycle Allis-Chalmers induction motors of standard and special design ranging in capacity from 5 to 50 horse-power. These motors, which are three-phase, 440-volt machines, are to be driven from three Allis-Chalmers engine units installed some months ago to replace a number of small isolated power plants in various parts of the plant. The electrical equipment, also furnished by Allis-Chalmers Company, comprises three revolving-field alternators wound for 25 cycles, one of 300-kw and two of 400-kw capacity.

ROSSITER-MACGOVERN COMPANY.—We noted recently in this department the formation of a new company, the MacGovern-Archer Company, of New York City, the members of which were the vice-president and sales manager, respectively, of the Rossiter-MacGovern Company. We are authoritatively informed that the Rossiter-MacGovern Company is now reorganizing with new capital, which will be ample for its operations, and that it will be active and prominent in the field in the same line as heretofore.

STATUS OF THE COPPER MARKET.—Dulness and sagging prices characterized the week in copper, prices declining at the increase of the visible supply. It was reported that the General Electric Company had purchased several million pounds of the metal at 12⅞ cents for delivery within 30 days, but, as a rule, the big companies are keeping away from the market, buying only for immediate needs. Until the securities market improves, and the demand for finished material increases, there is little likelihood of the large consumers changing their policy. Since Easter there have been unusually heavy shipments abroad, but the foreign consumption is not as large as the demand seems to indicate. On Monday the local market eased off in sympathy with the London market, where it was reported that Japanese producers were offering large blocks of the metal in competition with American producers. It is said that the Japanese have not been able to sell as much of the metal to China as formerly, and are obliged to seek new outlets for their production. Unless the home demand has increased immensely over the present demand by June, when the Amalgamated production will come on the market, there will have to be considerable reduction in export prices in the face of the Japanese supply, in order to maintain the status of the metal market here. Exports from the port of New York since April 24, totaled 700 tons, making the total shipments since the first day of April 24,646 tons. Closing prices on the Metal Exchange, Monday, were as follows:

| | | | |
|---|---|---|---|
| Lake | 12⅝ | @ | 12⅞ |
| Electrolytic | 12½ | @ | 12¾ |
| Castings | 12¼ | @ | 12½ |

The London market was as follows:

| | Noon. £ | s | d | Close. £ | s | d |
|---|---|---|---|---|---|---|
| Standard copper, spot | 57 | 15 | 0 | 57 | 12 | 6 |
| Standard copper, futures | 58 | 5 | 0 | 58 | 5 | 0 |
| Market | Easy. | | | Easy. | | |
| Sales of spot | 150 tons | | | | | |
| Sales of futures | 700 tons | | | | | |

Extreme fluctuations for the year:

| | Highest. | | | Lowest. | | |
|---|---|---|---|---|---|---|
| Electrolytic copper, spot | 13¾ | | | 12¼ | | |
| Lake copper, spot | 13⅞ | | | 12⅜ | | |
| Casting copper, spot | 13½ | | | 12⅛ | | |
| London, spot | £64 | 5 | 0 | £56 | 10 | 0 |
| London, futures | 64 | 10 | 0 | 56 | 17 | 0 |
| London, best selected | 67 | 10 | 0 | 61 | 0 | 0 |

ELECTRIC CAR LINE FOR PRETORIA, TRANSVAAL.—According to the report of Consul John H. Snodgrass, of Pretoria, Transvaal, the Town Council of Pretoria is considering changing the street-car line to an electric system and requests American manufacturers of street cars, overhead wires and iron and steel rails to furnish information as to the probable cost of an equipment of from 9 to 15 miles. Specific information is desired from the manufacturers by the Council as to the cost per mile for track, the cost of the overhead wire and the cost per car for ten or more. The type of car preferred is the ordinary light car that is used in the smaller cities of America. Letters or catalogues may be addressed to Dr. S. R. Savage, Mayor of Pretoria, or to the American Consul, P. O. Box 952, Pretoria, Transvaal, South Africa.

WILLIAMSBURG BRIDGE CABLES.—Dossert & Company, 242 West Forty-first Street, New York, have designed a special extension fitting for the solderless cable taps which are used as equalizers on the feeder cables supplying energy to Brooklyn Rapid Transit trains which are to run over the new loop connecting the Williamsburg and Brooklyn Bridges. The area of the cables ranges from 2,500,000 to 500,000 circ. mils. The work is under the direction of Latey & Slater, consulting engineers. The Gore Engineering & Contracting Company has placed orders for 244 sets of these large double taps, 164 regular taps and a number of two-way Dossert joints, including 134 connecting aluminum to copper.

HABIRSHAW WIRE COMPANY ELECTS OFFICERS.—At the annual election of the Habirshaw Wire Company, which was held on April 15, the following officers were chosen: Herbert L. Satterlee, president; Richard Irvin, first vice-president; R. S. Satterlee, second vice-president; F. J. Hall, treasurer, and J. B. Olson, secretary in charge of the sales department. Dr. W. M. Habirshaw was chosen chairman of the board of trustees.

PASSENGER SUBWAY FOR CHICAGO.—It is stated on good authority that Mayor Busse, in his coming message to the City Council, will advocate the building of a Chicago passenger subway which will cost about $30,000,000.

SANDUSKY, OHIO, CARBON PLANT ABANDONED.—The plant of the National Carbon Company, established at Sandusky, Ohio, 20 years ago, will be abandoned and the machinery shipped to Fostoria.

LIBERTY, IND., LIGHTING PLANT.—Mr. G. E. Stevenson, chairman of the Light Committee of the Council of Liberty, Ind., writes that the town invites the establishment there, by private capital, of a central station plant.

## Financial Intelligence.

THE WEEK IN WALL STREET.—Developments of a favorable character during the week gave a new impetus to the stock market, and brought securities to record levels for the year. The principal bullish feature was the announcement of the Pennsylvania 4 per cent long-term bond issue for $40,000,000, coupled with the information that foreign bankers of importance had combined with local interests to carry out the operation. Before the end of the week the subscriptions to the American allotment of $20,000,000, amounted to more than 200,000,000, and the effect on the general bond market was stimulating. The stubborn steadiness of the stock market during the present month, even in the face of the most bearish news, has created a strong impression that Wall Street, in the vernacular, is "bare of stocks," and also the impression that the end of the present upward movement is not yet in sight. From Wednesday afternoon, when the Pennsylvania plans became known, the market gained decidedly, Pennsylvania shares advancing from 116¾ to 119⅛. Reading and Union Pacific shared in the upward movement, and Steel issues were well supported. Amalgamated and American Smelting also advanced, while more or less strength was developed in Atchison, St. Paul, Southern Pacific, etc. Gold engagements by foreign houses, amounting to $5,000,000, caused no unfavorable comment, as money received from the interior continues to accumulate in the banks. The higher price of wheat, owing to a world scarcity, and the prospects of fine crops, point to a speedy recovery from the influences which have been dominating the country for the last few months. Shortly after the market opened on Monday, it was announced that subscriptions to the Pennsylvania bond issue had been closed, the number of subscriptions already received being more than 20,000, and amounting to hundreds of millions. This news, construed as forecasting the reception which would be meted to other bond issues, gave the market another upward lift, and closing prices on Monday were as follows:

NEW YORK.

| | Apr. 20. | Apr. 27. | Shares Sold. | | Apr. 20. | Apr. 27. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| All-Ch. | 7½* | 8 | 2,000 | Int-Met., com. | 10½ | 10½ | 14,550 |
| All-Ch., pfd. | 19* | 20⅞ | 4,180 | Int.-Met., pfd. | 27¾ | 28¼ | 20,300 |
| Amal. Cop. | 57 | 60⅛ | 108,200 | Mackay Cos. | 59¾ | 61½ | 1,000 |
| Am. D. T. | 39* | 39* | ——— | MackayCos.,pfd. | 64½ | 65½ | 100 |
| Am. Loc. | 44¼ | 47 | 9,645 | Met. St. Ry. | 29 | 20 | 300 |
| Am. Loc. Pfd. | 93½ | 100 | 2,000 | N.Y. & N.J. Tel. | 100* | 100* | ——— |
| Am. Tel. & C'bl. | 50* | 50* | ——— | Steel, com. | 37⅞ | 35⅞ | 340,370 |
| Am. T. & T. | 116½ | 118¾ | 7,200 | Steel, pfd. | 98¼ | 100⅜ | 34,370 |
| B. R. T. | 46½ | 47½ | 41,235 | W. U. T. | 50 | 51½ | 1,800 |
| Gen. Elec. | 132½ | 134 | 4,118 | West'h, com. | 55 | 56 | 9,900 |
| Hud. R. Tel. | — | — | ——— | West'h, pfd. | 60* | 68* | 100 |

PHILADELPHIA.

| | Apr. 20. | Apr. 27. | Shares Sold. | | Apr. 20. | Apr. 27. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Am. Rys. | 42½ | 44¾ | ——— | Phila. Elec. | 7⅞ | 7 15/16 | ——— |
| Elec. Co. of Am. | 9½ | 9½ | ——— | Phila. R. T. | 17½ | 18⅛ | ——— |
| Elec. Stor. B'ty. | 28 | 30 | ——— | Phila. Traction. | 89 | — | ——— |
| E. S. B'ty pfd. | — | — | ——— | | | | |

CHICAGO.

| | Apr. 20. | Apr. 27. | Shares Sold. | | Apr. 20. | Apr. 27. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Chicago City Ry. | 155 | 160 | ——— | Met. Elec. com. | 15 | 17 | ——— |
| Com. Edison. | — | 92 | ——— | Met. Elec., pfd | 47½ | 47 | ——— |
| Chicago Subw'y. | — | 18½ | ——— | National Carbon. | 56 | 57¼ | ——— |
| Chicago Tel. Co. | 118 | 118¼ | ——— | Nat. Carbon pfd. | 108 | 109¼ | ——— |

BOSTON.

| | Apr. 20. | Apr. 27. | Shares Sold. | | Apr. 20. | Apr. 27. | Shares Sold. |
|---|---|---|---|---|---|---|---|
| Am. Tel. & Tel. | — | 119 | ——— | Mass E. R., pfd. | — | 46½ | ——— |
| Comb'ind Tel. | — | 109 | ——— | Mex. Tel., pfd. | — | — | ——— |
| Edison El. Ill. | — | 213 | ——— | New Eng. Tel'p. | — | 114 | ——— |
| Gen. Elec. | — | 134½ | ——— | W'st Tel. & Tel. | — | 6 | ——— |
| Mass. Elec. Ry. | — | 9½ | ——— | W. T. & T. pfd. | — | 66½ | ——— |

*Last price quoted.
Shares sold are for week April 20-25.

BIRMINGHAM RAILWAY, LIGHT & POWER COMPANY.—The Birmingham Railway, Light & Power Company reports gross earnings for March of $177,003, and expenses and taxes of $112,686, leaving a net of $64,317. Deducting interest charges of $41,822, there remains a surplus of $22,495, and, deducting a reserve fund of $1,041, a balance of $21,454.

ELECTRICAL DEVELOPMENT IN WASHINGTON.—Col. A. M. Dewey, president and general manager of the Okanogan Electric Railway Company, has received advices that a $3,000,000 bond issue will be taken over by foreign investors. The money will be used in the construction of a standard gage electric railroad between Nighthawk and Brewster in Okanogan County, Wash. The road will extend from Nighthawk, in the northern part of Okanogan County, to Brewster, in the extreme southern part of the county, the head of navigation of the Columbia River. Construction work will be started at the middle and at both ends of the line before July 1, if the necessary labor can be procured, and it is expected that passenger and freight trains will be running in 18 months from the time work is begun. The road, including equipment, will cost $30,000 a mile. The company has already secured contracts for a large part of the right of way, and has a site for a power plant at Blue Lake, where it can develop 5,600 horse-power. An auxiliary plant will be erected at the conjunction of the two forks of Simon Creek, near Conconully. The stream has a fall of 1200 feet in the Peacock Mountains. After the water is used to drive electric generators it will be turned back into a reservoir for irrigation purposes. The territory covered has within its confines several of the largest mines in Washington. Ten thousand acres of land are already under the ditch on government and private irrigation projects, and there are 28,000 acres outside of these plants, while 40,000 acres more will be available within two years. The company plans to supply electrical energy to irrigate 6000 acres on the Okanogan River by lifting the water 100 feet to reach the land on two benches.

MERCHANDISE CREDITORS' COMMITTEE.—The secretary of the Merchandise Creditors' Committee of the Westinghouse Electric & Manufacturing Company has issued a letter to the creditors which says that a majority of the creditors have assented to the Merchandise Creditors' plan, but that the success of the plan depends largely upon the willingness of the creditors who have not yet signed the agreement to give the matter their immediate attention. "Unless it can be shown within a short time," the letter reads, "that the support of practically all of the merchandise creditors can be obtained, other and less desirable steps will necessarily have to be taken to secure a settlement of the company's outstanding obligations." Mr. J. W. Marsh, chairman of the Merchandise Creditors' Committee, said, in speaking of the work of the committee, "We are making very good progress and the outlook is encouraging. The committee represents $4,250,000. Of this amount more than $3,000,000 has been signed, or promised before the end of April. In the Pittsburg district alone the amount represented is more than $1,120,000. Of this amount $700,000 has been signed up and $300,000 additional promised by the end of April. The remainder of the creditors, representing about $1,000,000, the committee has not yet had the time to see, but reports indicate that the plan is approved generally. Naturally the Creditors' Committee is depending largely upon the present stockholders to do their share, and the Stockholders' Committee feel that it is making fairly good progress." An order authorizing the receivers for the Electric Company to return 2,500,000 francs (par value) debentures of the Société Anonyme of Paris to the society has been issued by Judge Young in the United States Circuit Court. The 2,500,000 francs is to be credited on the balance due on the Westinghouse subscription to 10,000,000 francs debentures of the Société Anonyme.

DIVIDENDS.—The directors of the Portland Electric Company have declared the regular quarterly dividend of 1½ per cent, payable April 30. The Automatic Electric Company has delayed dividend action until July 31; three months ago a dividend of 1½ per cent was declared. The National Carbon Company has declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable May 15. The directors of the American Gas & Electric Company have declared the regular quarterly dividend of 1½ per cent on the preferred stock, payable May 1. The directors of the Cambridge Electric Light Company have declared the regular quarterly dividend of 2½ per cent, payable May 1 to stock of record, April 21. The regular quarterly dividend of 1 per cent on the capital stock, payable May 15 to stock of record May 1, has been declared by the directors of the American District Telegraph Company. The directors of the Western Electric Company have declared the regular quarterly dividend of 2 per cent, payable May 1. The Connecticut Railway & Lighting Company has declared the regular quarterly dividends of 1 per cent on both its preferred and its common stock, payable May 15. The directors of the Ohio Traction Company have declared the regular quarterly dividend of 1¼ per cent, payable May 1. The Butte Electric & Power Company has declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable May 1.

ATLANTIC CITY LIGHTING BONDS.—The Atlantic City Electric Company, which controls the public lighting business of Atlantic City, has sold $1,000,000 first mortgage, refunding 5 per cent bonds to the banking house of Edward B. Smith & Company. The bonds are guaranteed, principal and interest, by the American Gas & Electric Company, which is controlled by persons affiliated with the General Electric Company. These bonds are part of an authorized issue of $6,000,000, of which $3,750,000 will be reserved for future extensions, and the remainder to take up a small amount of underlying bonds. The Atlantic City Company is a consolidation of four companies, three of which have perpetual franchises, and one has a franchise for 100 years. The net earnings of the company in 1907 were $131,846, or more than twice the interest charges.

EAST STROUDSBURG LIGHT, HEAT & POWER COMPANY.—The East Stroudsburg Light, Heat & Power Company, of East Stroudsburg, Pa., which has been formed recently, will erect a power plant on the Bushkill Creek. A concrete dam 470 ft. long will be constructed, and will reach 30 ft. above the creek level. A reinforced concrete flume about 1000 ft. long, giving 10 ft. more head will make 40 ft. head in all, which will furnish 10,000 hp during nine or ten months of the year. During the dry season it is figured that the power will fall as low as 120 hp and in all probability in addition to the hydraulic plant there will be an auxiliary steam plant. Mr. William H. Loder, of East Stroudsburg, is secretary of the company, and Mr. Lewis H. Grossart and Henry A. Kent, of the firm of Grossart & Kent, Stroudsburg, are the engineers.

NATIONAL ELECTRIC COMPANY.—Mr. John I. Beggs has made his final report as trustee of the National Electric Company, of Milwaukee, which was forced into bankruptcy by the defalcations of Frank G. Bigelow, now in prison. Dividends of a total value of 40½ per cent have been paid to creditors, and a final dividend of 1/3 per cent will be allotted. The winding up of the affairs of the concern was made possible by a recent decision of the United States Court of Appeals relative to the action begun against the bankrupt by the General Electric Company, for an alleged infringement of patent rights. The lower court decided in favor of the plaintiff, but the trustee appealed and the verdict was set aside. The settlement solved the last of the many difficult problems encountered in the administration of the affairs.

OFFICERS OF MARCONI WIRELESS COMPANY ELECTED.—At the annual meeting of the stockholders of the Marconi Wireless Company of America, held in Jersey City on April 21, Mr. John W. Griggs, of New Jersey, was elected president of the company; Mr. Guglielmo Marconi and Mr. John Bottomley (general manager), vice-presidents; Mr. W. W. Bradfield, treasurer, and Mr. George S. De Sousa, assistant treasurer. The new executive committee includes the president and vice-presidents and Mr. John D. Oppe, Mr. James M. Townsend and Mr. James W. Pyke. The following were elected directors for five years: Messrs. John W. Griggs, John D. Oppe, of Montreal, and James W. Townsend, of New York.

AMERICAN TELEPHONE & TELEGRAPH COMPANY.—The report for February of the American Telephone & Telegraph Company, which covers all except one of its associated operating companies, not including long-distance lines, shows a telephone revenue of $9,384,400, and general operating and maintenance expenses of $7,074,100. The balance from operation was $2,310,300; sundry earnings (net), $395,700; total net earnings, $2,706,000. The interest charges were $648,100, leaving a balance available for dividends of $2,057,900. Deducting dividends declared of $20,400, leaving $2,037,500.

NORTHERN OHIO TRACTION & LIGHT COMPANY.—The Northern Ohio Traction & Light Company reports gross earnings for March, $129,659, as compared with $133,834 for 1907; expenses of $81,273, against $83,215, making the March net $48,386, as compared with the net for the same period last year of $50,619; the March surplus was $4,433, a decrease from the $9,329 of March last year. The three months' net was $133,454, as compared with $140,377 for the same three months of 1907, and the three months' surplus was $4,594, against a surplus of $16,348 for 1907. In 1906 the surplus for the three months showed a deficit of $9,605.

NORTH AMERICAN COMPANY TO ISSUE $5,000,000 IN BONDS.—The North American Company is preparing to place on the market about $5,000,000 bonds of certain of its subsidiary companies, and it is probable that the issue will appear within a month. "The North American Company has been negotiating with several well-known banking firms for some time," said Secretary Burt, "with a view to putting out a bond issue of probably not more than $5,000,000. The question as to the rate of interest has delayed matters somewhat, but the proper steps in the matter of arranging for mortgages have been taken, and as soon as the rate of interest has been decided the negotiations will be speedily concluded. But we are in no haste, as the bond market is improving each day. Just which of the companies will appear on the bonds is still undecided, and an effort is being made to discover which of the 12 companies in whose names the bonds might be issued would appeal the most to bankers and investors. Spencer Trask & Company have found a good market in the West for the $2,000,000 bond issue of the Milwaukee Light & Traction Company, which was put out about two weeks ago, and it is expected that the coming bond issue, under the improved conditions, will have an even better sale." Announcement was made later by N. W. Harris & Company that they had completed arrangements with the North American Company for the purchase of $5,500,000 refunding mortgage 5 per cent bonds of the Union Electric & Power Company, of St. Louis, which is controlled by the North American Company, and has practically a monopoly of the lighting and industrial business in St. Louis. On Dec. 2, 1907, this company increased its authorized bond issue from $10,000,000 to $18,000,000, which was done to help finance in part the purchase by it of the Edison Electric Illuminating Company and the Laclede Power Company. At the same time its authorized stock was increased from $10,000,000 to $18,000,000. The North American Company itself has done no financing since last May, when it issued $5,000,000 5 per cent notes to a syndicate headed by Redmond & Company, and Lee, Higginson & Company. Recently notice was given that all of these notes had been sold.

REPORT ON INTERBOROUGH MORTGAGE.—Chairman William R. Willcox, of the Public Service Commission, has issued a report of the hearings held on the application of the Interborough Rapid Transit Company to issue $25,000,000 of three-year 6 per cent gold notes, and $30,000,000 of bonds. The report discusses the existing indebtedness of the company, its available assets and its present earning capacity in detail, and the Commissioner concludes that the net income is more than ample to meet the notes and bonds, without reference to the dividends on the stock. A number of changes in the form of the bond issue were suggested by the Commissioner, and acquiesced in by the company. Six hearings on the application were held, and there were no objections advanced against the bond issue, except on the part of the Continental Securities Company, which holds 300 shares of stock. These objections were overruled by the Commissioner. Following the Commissioner's report the commission formally approved a mortgage on all the property of the Interborough Rapid Transit Company for $55,000,000. For the present only $30,000,000 in bonds will be issued to secure an issue of notes for $25,000,000 running for three years and bearing 6 per cent interest. J. P. Morgan & Company have undertaken to form a syndicate to underwrite the notes, which will be taken at 97 plus accrued interest from Nov. 1, 1907, the date of the bonds. The proceeds of the note issue will be used to refund another issue of $15,000,000, maturing on May 1, and to wipe out certain floating indebtedness. At the end of two years and a half the holders of the notes will be allowed to exchange them for bonds at 99. The commission inserted a stipulation, the first of its kind in connection with railway bonds in this state, that with the exception of the bonds exchanged for the $25,000,000 note issue, no bonds may be issued by the company at less than par, except after advertising for bids. Arrangements are made for a sinking fund of not less than $300,000 a year, beginning on Nov. 1, 1910.

STONE & WEBSTER PROPERTIES.—Below are given the gross earnings for February, 1908, of each of the companies controlled by Stone & Webster, and the increase or decrease in net earnings, as compared with February, 1907: Cape Breton Electric Company, Limited, $18,024.43, inc. $2,312.75; Edison Electric Illuminating Company, of Brockton, Mass., $18,604.28, inc. $871.13; Electric Light & Power Company, of Abington and Rockland, $5,037.62, dec. $1.64; Fall River Gas Works Company, $31,325.35, dec. $444.44; Minneapolis General Electric Company, $84,583.83, inc. $4,160.73; Lowell Electric Light Corporation, $28,906.15, dec. $1,596.80; Houghton County Electric Light Company, $21,909.80, dec. $1,551.91; Tampa Electric Company, $48,568, inc. $7,466.15; Puget Sound Electric Railway, $117,502, inc. $847.61; Seattle Electric Company, $346,127, dec. $5,141.30; Savannah Electric Company, $43,718, dec. $11,393.93; Brockton & Plymouth Street Railway Company, $6,341, dec. $563.03; Whatcom County Railway & Light Company, $27,569, inc. $284.40; Properties of Columbus Electric Company, $28,844, inc. $1,955.59; Dallas Electric Corporation and Subsidiary Companies, $84,186, inc. $7,269.80; El Paso Electric Company and Subsidiary Company, $43,863, inc. $6,283.41; Northern Texas Electric Company and Subsidiary Company, $71,311, inc. $2,848.79; Galveston-Houston Electric Company, $74,715, inc. $195.67; Houghton County Street Railway Company, $17,336, inc. $1,488.10; Pensacola Electric Company, $15,378, dec. $4,589.03; Jacksonville Electric Company, $31,378, dec. $1,721.30.

NEW ORLEANS RAILWAY & LIGHT COMPANY.—The annual report for the year ended Dec. 31, 1907, of the New Orleans Railway & Light Company shows gross earnings of $6,041,301, an increase of $268,110.87, or 4.6 per cent over the previous year. Operating expenses were $3,270,396.93, an increase of $196,381.84 over the previous year, due mostly to an increased volume of business in the railway and gas departments and to an increase of ½ cent per hour in wages to employees. After paying $312,500 to the preferred stockholders, there remained a surplus of $432,766.56.

CHICAGO CITY RAILWAY.—The report of the Chicago City Railway for the year ended Jan. 31, 1908, gives a gross income of $8,215,196, as compared with $7,871,126 for 1907, and a net of $2,464,559, as against $1,724,822 for 1907. Deducting interest of 5 per cent on the valuation from the net leaves a surplus of $1,228,550, as compared with $104,822 for the previous year. Of this surplus $675,703, or 55 per cent, went to the city of Chicago, and the remainder, $552,847, to the City Railway Company. The total valuation of the property, as of Jan. 31, 1908, was $29,052,145.

UNITED RAILWAYS OF ST. LOUIS.—The report of the United Railways of St. Louis gives a March gross of $858,908, a decrease of $44,237 from last year. The net for March was $299,773, a decrease of $7,125 from March, 1907. After deducting charges there remained a surplus of $66,483, which is a decrease of $9,547 from the corresponding month last year. The net for the three months ending March 31 was $828,716, an increase of $57,160 over the same period last year. The three months' surplus was $128,554, an increase of $50,732 over the same three months in 1907.

MICHIGAN STATE TELEPHONE COMPANY.—The report of the Michigan State Telephone Company for the two months ended Feb. 29, 1908, gives a gross income of $528,166, and expenses of $397,755, making a net of $130,411. Interest charges were $69,686, and the surplus $60,725. Deducting the preferred dividend of $22,832, there is a net surplus of $37,893. The earnings, as given, after providing for the payment of interest charges and preferred dividends, are at the rate of 6.4 per cent on the $6,000,000 common stock.

CUMBERLAND TELEPHONE & TELEGRAPH COMPANY.—The report for March of the Cumberland Telephone & Telegraph Company gives gross earnings of $506,300, an increase of $31,320 over March, 1907, leaving a surplus, after deducting charges, of $173,164, which shows an increase of $22,350 over the corresponding month in 1907.

MEMPHIS STREET RAILWAY.—For the year ending December 31, 1907, the report of the Memphis Street Railway Company gives gross earnings of $1,604,384, against $428,935 for 1906, and a net of $597,233 against $590,708 for 1906. The net surplus for 1907 was $67,411, which is equal to 2.68 per cent on the $2,500,000 common stock.

NEW YORK & NEW JERSEY TELEPHONE COMPANY.—The gross earnings of the New York & New Jersey Telephone Company for the quarter ending March 31, 1908, (March estimated) were $2,207,202, and the net earnings $581,264. The surplus for the quarter was $108,264, and the surplus on hand March 31, 1908, $4,940,478.

UNITED RAILWAYS & ELECTRIC COMPANY.—The United Railways & Electric Company, of Baltimore, Md., reports gross earnings for the quarter ended March 31, of $1,517,662, a decrease of $13,680 from the corresponding quarter of last year.

# GENERAL NEWS

*Late items are printed unclassified at end of department*

## Construction News.

FOLEY, ALA.—Plans are being considered by the Consumers' Service Corporation for the construction of an electric light and power plant and municipal water works system. For further information address John Walker, of Magnolia Springs.

NORTH BIRMINGHAM, ALA.—The citizens on April 20 voted to issue $5,000,000 in bonds, the proceeds to be used for the construction of a municipal electric light plant and water works system.

SLOCOMB, ALA.—The contract for the construction of the municipal electric light plant has been awarded to J. B. McCrary & Company, of Atlanta, for $6,000.

ARKADELPHIA, ARK.—A 50-year franchise has been granted to R. E. L. Eagle, of Lonoke, who is interested in the organization of an independent telephone company in this city.

OSCEOLA, ARK.—The Mississippi Valley Telephone Association has decided to expend about $30,000 in improving its long-distance service.

ARTESIA, CAL.—A telephone company is being formed for the purpose of installing a telephone system covering this city, Norwalk and Los Alamitos.

CHICO, CAL.—J. W. Roper, of the Midas Gold Mining Company, of Shasta, announces that the company will expend between $40,000 and $50,000 in the erection of a power plant on Bee Gum Creek to furnish power for the mine. Mr. Roper and L. A. McIntosh have filed a notice of appropriation of 5000 in. of water in Bee Gum Creek.

EUREKA, CAL.—Messrs. Swanson & Pererson, proprietors of the Western Hotel, are planning to install an electric plant.

JUNCTION CITY, CAL.—The North Mountain Power Company, which was recently merged with the Eureka Lighting Company, is planning to build a power plant at Big Flat, on Trinity River, about 15 miles from Junction City, and will develop 4000 horse-power, for which surveys have been made and plans drawn. It is proposed to utilize the water of Cut Throat Gulch. A dam will be thrown across the gulch, making a large storage reservoir. The transmission line from Eureka to Junction City is 80 miles in length.

GOLDFIELD, CAL.—The Nevada-California Power Company is preparing to install a fourth Allis-Chalmers 1500-kw hydro-turbo-generator set to meet the increasing demand for electricity, pending the completion of its new hydro-electric stations on Bishop Creek, Cal. Electricity from the present Bishop Creek plant is transmitted to Tonopah and Goldfield, a distance of 113 miles, at 60,000 volts.

PETALUMA, CAL.—The Petaluma & Santa Rosa Railway Company may extend its electric railway to Healdsburg and Cloverdale.

REDLANDS, CAL.—The Yucaipa & Oakglen Railroad has been reorganized and plans have been completed for the construction of an electric railway from Redlands to Yucaipa, a distance of seven miles. Later it is expected to extend the railway to Oakglen, 22 miles from Redlands, and eventually the road will be extended to Beaumont and San Jacinto. The officers of the company are: J. F. Neeland, of Los Angeles, president; C. S. Chesnut, of Redding, vice-president; M. N. Newmarket, of Los Angeles, treasurer.

UKIAH, CAL.—The Ukiah Water & Improvement Company is contemplating the installation of a 60-hp electric pumping plant at its station on the Russian River.

WOODLAND, CAL.—A meeting of the stockholders of the Jeanette, Montclair & Woodland Traction Company will be held in Washington, D. C., to reorganize the company. The company is planning to construct an electric railway from Woodland to Brawley, Cal., work on which will begin this summer. We have been advised that the company will be in the market for equipment in the near future. The officers of the company are: Albert Mollizal, president; Ladd Veitt, of Tulsa, Okla., vice-president; Bruce Clark, of El Reno, Okla., treasurer, and A. E. Culley, New York, N. Y., secretary and manager.

DENVER, COLO.—The Intermountain Railroad, formerly the Denver, Lakewood & Golden, which is now equipping its line to be operated by electricity, expects to have the electric service in operation within 30 days.

PUEBLO, COLO.—Plans are being considered by the Northern Electric Company, of Madison, Wis., for the construction of a large electric plant at the Cañon City coal fields to furnish electricity for railway purposes, irrigation, etc. A. B. Hulit is interested in the enterprise.

HARTFORD, CONN.—The New York, New Haven & Hartford Railroad Company has petitioned the State Railroad Commissioners for an approval of the layout and method of construction of the proposed electric railway between Hartford and Middletown.

MERIDEN, CONN.—The Meriden Electric Light Company has installed in its plant a 500-kw, Allis-Chalmers turbo-generator set and a 400-hp Hazleton boiler equipped with a Murphy mechanical stoker. Charles A. Learned is superintendent.

DOVER, DEL.—The Board of Water Commissioners has petitioned the Council for authority to spend $1,000 to equip the pumping station to be operated by electricity. A gasoline engine is being used at present.

ATLANTA, GA.—D. G. Zeigler & Company, of this city, are considering a proposition to establish a hydro-electric plant on the Sewanee River, where 25,000 horse-power can be developed at a minimum cost of about $130,000. It is proposed to furnish electricity within a radius of 60 miles for electric railways, motors and lamps. Among the towns within this radius are Jacksonville, Fla.; Lake City, Fla.; Valdosta and Waycross, Ga.

MACON, GA.—The Macon Railway & Light Company is making improvements to its system and is planning to install a 3000-hp turbo-generator set in its power house.

MACON, GA.—The Bibb Power Company has let the contract for the construction of a large dam near Jackson. The machinery for the plant has been purchased. W. Jordan Massee is president of the company.

SPARTA, GA.—J. B. McCrary & Co., of Atlanta, have secured a contract from the town of Sparta to install an electric light plant, in connection with a water-works system.

CAIRO, ILL.—The Home Telephone Company will rebuild its lines to Mound City.

CHICAGO, ILL.—The Interstate Automatic Telephone Company has been granted a franchise in East Chicago, Ind. The company has also made application for a franchise in Gary.

CHICAGO, ILL.—Arrangements are being made to have the Northwestern Elevated Railroad Company handle freight between Evanston and Wilson Avenue by electricity. The elevated road extension runs over the right of way of the St. Paul Railroad to Evanston, and rather than have the locomotives in the way the Northwestern Elevated will haul the freight cars of the other road.

PINCKNEYVILLE, ILL.—Surveys and estimates have practically been completed for the proposed electric railway of the Belleville-Pinckneyville Traction Company. The line will be about 46 miles in length. The company is capitalized at $100,000 and expects to issue $1,250,000 in bonds. L. D. Turner, of Belleville, is president of the company.

ROCK ISLAND, ILL.—The City Council has granted the Union Electric Telephone & Telegraph Company a 25-year franchise.

BROOKVILLE, IND.—The citizens are considering the question of establishing a municipal electric light plant in this place.

COLUMBUS, IND.—Extensive improvements are contemplated by the Central Indiana Lighting Company during the summer, which include the construction of a new power plant, the partial rebuilding of the street car lines and extension of the electric light service. The company also proposes to furnish steam heat to local consumers. New street cars will also be purchased.

CRAWFORDSVILLE, IND.—C. F. Street, president of Street, Wykes & Company, of New York, N. Y., has purchased the Crawfordsville Water & Light Company's property at a sale by master in chancery, who acted upon the order of the Federal Court. The consideration was $76,000. The property sold covers the entire holdings of the company in this city, including the water works and artificial gas plant. S. C. Rowland, who has been receiver of the company, will continue to act as general manager of the plant.

DANVILLE, IND.—The Farmers' Mutual Telephone Company has been granted a franchise to install and operate a telephone system in this city.

DECKER, IND.—Senator Hemenway has notified Eugene Rush, head of the Decker Power Dam Company, that an amended bill permitting the building of a large dam in White River at Decker would go through, but would limit it to a term of years, and that the Government shall receive pay for the franchise. This settled, work will begin soon.

EVANSVILLE, IND.—The Evansville Terminal Railway Company will soon let the contract for grading its entire road. No arrangements have yet been made in regard to the location of the power house. A. F. Hayes, of Evansville, is president of the company.

GREENFIELD, IND.—A company is being formed to take over the Hannah-Jackson telephone system, which has been in the hands of a receiver, and out of use for some time. The system extends throughout the city and the surrounding country. The new company contemplates making many extensions to the lines and installing new equipment. R. L. Mason is interested in the project.

HAMMOND, IND.—The Citizens' Light & Power Company, recently incorporated, has applied for a franchise to operate electric light and gas plants. The company proposes to erect a steam plant. A. J. Campbell is interested in the company.

MARION, IND.—Plans are being considered by the United Telephone Company to rebuild its plant in this city.

ATLANTIC, IA.—It is reported that bids will be received about May 15 for reconstructing the municipal electric light plant and water works system at a cost of about $50,000. J. L. Darnell, Nelson Building, Kansas City, Mo., is engineer.

MUSCATINE, IOWA.—The City Council is considering the construction of a municipal electric light plant.

OELWEIN, IA.—The Corn Belt Telephone Company contemplates the construction of several metallic lines out of Oelwein.

CONWAY SPRINGS, KAN.—The question of installing an electric light plant is under consideration here to cost $10,000.

SANTE FE, KAN.—Plans are being considered for the organization of an Independent telephone company to erect lines throughout the county and to make connections with Garden City and Plains. The capital stock of the company is placed at $3,000, and about 100 miles of line will be erected.

LOUISVILLE, KY.—Bids will be received by the Board of Public Works until May 12 for the so-called Fetter franchise for electric lighting.

LOUISVILLE, KY.—The Louisville Railway Company is contemplating the extension of the Okolona line to connect Mt. Washington with Shepherdsville, a distance of 16 miles.

SCOTTSVILLE, KY.—The plant and franchises of the Gainesboro Telephone Company in this city have been purchased by the Farmers' Home Telephone Company, recently organized. The new company will connect at once with 18 independent exchanges, having in all about 1500 subscribers in nine counties in Kentucky and Tennessee. The officers of the new company are: G. C. Hicks, president, C. E. Hanes, secretary, and J. M. Slate, treasurer.

SHREVEPORT, LA.—J. W. Atkins, secretary and treasurer of the Shreveport Suburban Railway Company, has purchased the franchise permitting the operation of a street-car line from the city limits to the intersection of Grimmer Avenue and King's Highway. The company is building a line from the terminus of the Marshall Street line to Gladstone.

PEMBROKE, MAINE.—The city electric lighting system was not interfered with by the destruction of the Pembroke plant; the old station of the Eastport Electric Light Company is supplying the system for the present. The plant at Pembroke will be rebuilt at an early date, it is said.

PORTLAND, MAINE.—The City Council has authorized the committee on street lighting to contract with the Portland Lighting & Power Company for lighting the streets, squares, etc., and public building, including the Deering district, for a period of five years from April 1, 1908, with the right to renew for another five years. Under the terms of the contract the company is to furnish not less than 330 arc lamps of 1200 candle-power each at $60 per lamp per year; not less than 150 incandescent street lamps of 65 candle-power at $30 each per year; not less than 25 incandescent street lamps of 30 candle-power at $18 per lamp per year; for incandescent street lamps of 25 candle-power at $16 per lamp per year and not less than 540 incandescent street lamps of 16 candle-power at $9 per lamp per year; and for electrical energy required by the city at a rate of 4½ cents per kw-hour.

BALTIMORE, MD.—The Maryland Electric Railways Company, which now owns and operates the Annapolis Short Line Road, will continue its service into the Camden station over the tracks of the Baltimore & Ohio Railroad, which will be electrically equipped for that purpose.

BALTIMORE, MD.—The residents and property holders along the Philadelphia Road have taken steps to build an electric railway from the city line to Grange Hall, a distance of six miles. The cost of the road is estimated at $60,000, and it is proposed to lease the rolling stock and secure electricity from the United Railways & Electric Company. John J. Hurst and C. Ross Mace are interested in the project.

COWENTOWN, MD.—The rolling-mill property has been purchased by the Newark Electric Company, of Newark, Del. The company proposes to build a hydro-electric plant at this place.

ATTLEBORO, MASS.—The contract for the construction of the extension of the Interstate Railway to South Attleboro has been awarded to Eveline Brothers for $65,000. The contract includes the construction and complete equipment of the road.

DOUGLASS, MASS.—The Selectmen have entered into a contract with the Douglass Electric Company for lighting the streets of the town for a term of three years at the rate of $13.50 per lamp per year for incandescent lamps of 32 candle-power, to be operated on a moonlight schedule.

NEW BEDFORD, MASS.—A new schedule of rates for electricity for motors has been adopted by the New Bedford Gas & Edison Light Company, to go into effect May 1. Under the new schedule the rate is 12 cents per kw-hour for the first 15 days of each month. All additional energy will be furnished at the following rates: First 200 kw-hours at five cents per kw-hour; next 200 kw-hours at four cents per kw-hour, and all additional at the rate of three cents per kw-hour; subject to a discount of five per cent on all bills if paid on or before the tenth of the month. The company has under consideration a new schedule of lighting rates.

PEABODY, MASS.—At the annual town meeting held April 11 the proposition to appropriate $58,000 for remodeling the municipal electric light plant was defeated.

DETROIT, MICH.—The Ontario Power Company is said to be considering a proposition to construct a high-tension transmission line from Niagara Falls to the Detroit River. Gen. F. V. Greene is vice-president.

GRAND RAPIDS, MICH.—The Grand Rapids Street Railway Company is planning to build three extensions on different lines this year. J. C. Madigan is superintendent of the company.

LANSING, MICH.—The new hydro-electric plant of the Michigan Power Company at the old Piatt Dam is practically completed at a cost of nearly $200,000. The new plant will have an output of nearly 2000 hp, divided into two units consisting of two 50-in. Leffel water turbines connected to a 540-kw generator. Electricity from this plant will be transmitted to Lansing by four circuits, one of which is now in operation and extends to the Washtenaw Street power plant; one of the circuits will be used exclusively for lighting; an additional circuit will be built to replace the old circuits for supplying energy to the Leo Motor Car Company and Hugh Lyons Company, and will be extended north to connect with the circuit now in operation on Kalamazoo Street. The company has authorized plans and specifications prepared for the construction of a hydro-electric plant at Diamondale, and for a new steam power plant of 2350 hp, which the company proposes to construct on the banks of the Grand River, and which will be used as an auxiliary to the hydro-electric plants. The cost of the plant and equipment is estimated at $150,000. W. H. Zimmerman is general manager of the company.

MARQUETTE, MICH.—We are informed that the Marquette, Negaunee & Ishpeming Interurban Railway Company is making plans to begin construction work on its proposed railway. The railway will be about 14 miles in length and will be operated by electricity, but as yet the site for the power station has not been located. L. M. Sigler, of Cleveland, Ohio, is president, and the Roberts & Abbott Company, of Cleveland, Ohio, will have charge of the engineering work.

CLOQUET, MINN.—E. P. Coleman, of Duluth, general manager of the Great Northern Power Company, writes that there is no probability of any construction work being undertaken by this company this year.

FERGUS FALLS, MINN.—Plans are being prepared by Edward Burch, consulting engineer, of Minneapolis, for the construction of a 28-mile, 25,000-volt transmission line between Wahpeton, N. D., and Fergus Falls for the Otter Trail Power Company.

LUVERNE, MINN.—E. C. Schwartz, city recorder, writes that the city does not contemplate making any changes to the municipal electric light plant or water works system.

NATCHEZ, MISS.—Plans for installing electrical machinery in the water works plant to generate electricity for lighting the streets and public buildings will be prepared by Krumbhaar & Aiken, Denegre Building, New Orleans, La., engineers.

OXFORD, MISS.—The University of Mississippi will receive competitive designs, plans and specifications for a $50,000 dormitory, $25,000 dining hall and $35,000 electric light and power plant, to be submitted on or before May 20, 1908. For particulars apply to D. M. Kimbrough, chairman building committee.

CENTRALIA, MO.—The city has voted to buy the electric light plant, but on some technicality the Town Board refuses to pay the money. E. H. Baldefige, head of the system, declares the plant belongs to the city and he refuses to wire any buildings. As a result several buildings are in darkness.

POMONA, MO.—A telephone line is being erected from Pomona to Cordez and a central exchange is to be established at Monroe. C. H. Duckett and Monroe Woods are interested in the project.

BUTTE, MONT.—The North Butte Extension Copper Company has made a contract with the Butte Electric & Power Company to supply electricity for lamps and motors for its mines.

HELENA, MONT.—M. H. Gerry, Jr., manager of the Helena Power Transmission Company, has announced that the material has been ordered for the construction of a large dam, which will be known as the third dam on the Missouri River, 30 miles from Helena. When completed it will furnish water to irrigate thousands of acres of land in this section and also will furnish power for plants in Helena, Butte and Anaconda.

SUTHERLAND, NEB.—The Village Board has granted a franchise to the Sutherland Telephone Company to install a local telephone system.

RENO, NEV.—Among the improvements to be made at the State Insane Asylum is the installation of a new laundry, a cold-storage plant and a power plant. The last Legislature appropriated $18,000 for improvements to the institution.

NEWARK, N. J.—Two estimates have been submitted to the public buildings committee of the Board of Freeholders for electric light plants, one to be installed at the court house and the other at the jail. The estimate for the court house was submitted by Runyon & Carey. The cost of the plant was estimated at $26,497, and the cost of operation would be $5,261 per year. The Public Service Corporation now furnishes electricity for the building for which the county pays approximately $10,000 per year. The estimate on the plant for the jail was submitted by James Seymour, and the cost of installation placed at $6,000, which could be reduced by $1,000 if the present boilers are used.

WASHINGTON, N. J.—The Easton & Washington Transit Company is said to be contemplating the extension of its system to Lake Hopatcong, a distance of about 20 miles, this summer. The company is also planning to extend the road from Lake Hopatcong to Hoboken, a distance of 24 miles, in 1909.

BERGEN, N. Y.—The Genesee County Electric Light, Power & Gas Company, of Batavia, has been granted permission by the Public Service Commission to furnish electricity in Bergen. The company will also supply electricity for the pumps at the water works plant, as well as for lighting. R. M. Walker is secretary of the company.

HOOSICK FALLS, N. Y.—Plans are being made for extensive improvements to the Bennington & Hoosick Valley Railway, which will involve an expenditure of about $100,000.

HORNELL, N. Y.—Surveys are being made for the Dansville branch of the Rochester, Elmira & Corning Electric Railway.

NEW YORK, N. Y.—Bids will be received by C. B. J. Snyder, superintendent of school buildings, until May 4, for installing electric equipment in new Public School No. 56, Richmond Hill, Borough of Queens.

PATCHOGUE, N. Y.—The South Shore Traction Company is planning to begin work on the construction of its road within the village of Babylon. The company, it is understood, will purchase electricity from the Long Island Traction Company for operating the road for the present.

SPENCERPORT, N. Y.—Plans are being made by the Ogden Telephone Company to commence work on the construction of its system, which will include about 45 miles of pole line and exchanges in this city and Adams Basin, involving an expenditure of about $16,000.

CASSELTON, N. D.—Surveys are being made for the proposed extension of the Northwestern Interurban Railway Company connecting with the Soo line on the west at Enderlin. James J. Lumbrecht is president.

KENSAL, N. D.—A company has been formed by L. C. Lane and others to install an electric light plant and to take over the telephone system.

LIMA, OHIO.—The offer of W. Kelsey Schoepf for a new contract for street lighting at $70 per arc lamp was refused by the Council, which voted to issue bonds to the amount of $80,000 for the erection of a municipal lighting plant. It is intended to equip the plant to furnish electricity for commercial lighting, in competition with the local company, which is controlled by the Lima & Toledo Traction Company. The company's contract with the city calls for $85 per year for each arc lamp and does not expire until 1910.

NEWARK, OHIO.—Arrangements have been made for financing the construction of the Newark, Martinsburg & Mt. Vernon Electric Railway Company's road from Newark to Mt. Vernon. The company is to be reincorporated with a capital stock of $2,000,000. Frank E. Elliott, of Martinsburg, is president and secretary of the company.

SPRINGFIELD, OHIO.—The Washington Traction Company, which is a successor to the Springfield, Charleston, Washington & Chillicothe Railway Company, will be sold at a receiver's sale May 11. The company at present operates an electric railway from Springfield to Charleston, a distance of 14 miles, and when completed will extend to Chillicothe, a distance of about 54 miles. S. B. Lankin is receiver.

BEULAH (P. O. DOXEY), OKLA.—J. A. Corbell is reported to be interested in a project to establish an electric light plant in this place, which will have an output equivalent to 200 lamps.

GRANTS PASS, ORE.—A rural telephone company has been formed in this city for the purpose of building a telephone line to Fruitdale. G. A. Hamilton, Prof. Turner and Robert Huck are interested in the enterprise.

LENTS, ORE.—The Mount Scott Telephone Company has been granted a franchise to construct a telephone line from Lents to Happy Hollow.

PENDLETON, ORE.—Plans are being considered for the construction of an electric railway from Pendleton to Irrigon and intervening towns. The proposed road will be about 50 miles in length. Dr. Henry Waldo Coe is interested in the enterprise.

WOODBURN, ORE.—The Monitor Mutual Telephone Company has petitioned the County Commissioners for permission to erect a telephone line from Monitor to Woodburn, McKee and Mount Angel.

ETTERS, PA.—Plans are being made by the Borough Council for the construction of an electric light plant, for which a site on the Little Conewago Creek has been donated by Charles Williams, of Goldsboro. An ordinance has been passed by the Council appropriating $9,000 to erect the power house and install the machinery. A dam will be built across the creek to utilize the water power to operate the plant. The street lighting system will consist of 25 arc lamps of 2000 candle-power each.

SLATINGTON, PA.—The Franklin & Towamensing Street Railway Company has completed preliminary surveys and secured the right of way for its proposed electric railway between Slatington and Lehighton, a distance of about 10 miles. It is expected that work on the construction of the railway will begin this spring. A. P. Berlin is president.

CHESTER, S. C.—The citizens on May 5 will vote on the proposition to issue $26,000 in bonds to extend the light and water systems and for street improvements.

LAURENS, S. C.—The City Council has entered into a contract with the Reedy River Power Company for supplying the city of Laurens with electricity for a term of ten years. The contract calls for a minimum of 133 horse-power at a rate of $50 per horse-power per year, with a 24-hour service. The city, it is understood, will distribute electricity in amounts of 3 horse-power and under, while the power company will be permitted to make contracts for larger amounts. The municipal plant will be held in reserve for emergency.

ALCESTER, S. D.—A telephone company has been organized by August Ludwig, John Bergdale, L. Erickson, J. G. Hoard, and others, to furnish a telephone service in this city and surrounding country. The company has submitted a proposition to the Hawarden company to purchase its South Dakota lines, with a view of making them part of the proposed system.

HEATON, S. D.—An independent telephone company has been organized in this city and proposes to install a local exchange and build telephone lines into the surrounding country.

CEDAR GROVE, TENN.—An independent telephone company has been formed in this city and the following named officers elected: G. C. Clark, president; C. M. Montague, vice-president; A. L. Smight, secretary; John W. Barham, treasurer, and J. W. Witherspoon, general manager.

BANDERA, TEX.—The capital stock of the Bandera Telephone Company has been increased from $4,000 to $7,000.

GAINESVILLE, TEX.—The Gainesville-Whitesboro-Sherman Interurban Railway Company has awarded the contract for the construction of its road to the Tennessee Construction Company.

GONZALES, TEX.—The capital stock of the Citizens' Light & Power Company has been increased from $10,000 to $15,000.

KIRBYVILLE, TEX.—An electric light company is being organized here. Mr. Simmons, editor of the Kirbyville *Banner*, is interested in the project.

TEMPLE, TEX.—The citizens are agitating the question of purchasing the local electric light plant to be operated by the municipality or the construction of a new plant. It is said that the plan meets the approval of Mayor Hamill.

HARRISONBURG, VA.—The Harrisonburg Mutual Telephone Company contemplates placing its wires in underground conduits in the business section of the city.

ONANCOCK, VA.—Plans are being made by the Accomac Traction & Power Company to commence work on the construction of its proposed railway in about 60 days. The road will be about ten miles in length and will connect Anancock, Tasley, Accomac and Metomphim Bay. T. W. Taylor is secretary.

PULASKI, VA.—The question of improving the municipal electric light plant is being considered by the City Council.

SPRAGUE, WASH.—The plant and holdings of the Sprague Light Company have been purchased by Eugene Enloe, of the Big Bend Light Company, a subsidiary of the Washington Water Power Company. Work will commence at once connecting the transmission line from Sprague with the line from Harrington to Ritzville.

VANCOUVER, WASH.—The Washington Railway & Power Company, a local organization which owns the franchise and has built part of the street railway system, has turned over its property and holdings to the citizens of Vancouver. It is proposed to raise $20,000 to complete the system and put it in operation. Bonds will be issued to pay for the company's interest. Temporary trustees have been appointed, as follows: G. R. Percival, S. W. Thompson and J. M. Lay.

WASHOUGAL, WASH.—The County Commissioners have granted a franchise for an electric lighting system to C. L. Pritchard.

WENATCHEE, WASH.—The Valley Power Company has placed orders for machinery for its power plant, which it will install in the Wenatchee Valley this summer. The company proposes to furnish electricity to pump water for irrigation purposes, and will furnish energy to the Wenatchee Canal Company for drilling through Shotwell Hill. The plant will have an output of 4000 horse power, the cost of which is estimated at $100,000. W. T. Clark, Marvin Chase and ex-Mayor Scheble are interested in the enterprise.

FAIRMONT, W. VA.—The Fairmont & Clarksburg Traction Company is contemplating the construction of a power plant at Clarksburg.

MASONTOWN, W. VA.—Work has commenced on the construction of a new traction system connecting Morgantown, W. Va., and Pittsburg, Pa., a distance of 120 miles, by the Brownsville, Masontown & Smithfield Street Railway Company. The contract for the construction of the road has been awarded to the Pennsylvania Railroad Construction Company. The power plant will be located at West Masontown, on the Monongahela River. E. C. McCullough, of Uniontown, is chief engineer of the company.

WHEELING, W. VA.—Plans have been made for extensive improvements to the system of the City & Elm Grove Railway Company, which will include increasing the equipment of the power house, building of several miles of double track and installation of feed wires, etc., the cost of which is estimated at from $60,000 to $75,000. The company contemplates installing steam turbines.

MENOMINEE, WIS.—The telephone lines of the Daggett-Nathan Telephone Company will be extended from Nathan to Faithorn Junction.

MENOMINEE FALLS, WIS.—The State Railroad Commission has authorized the Menominee Falls Electric Light Company to issue $10,000 in capital stock and $6,000 in bonds. J. G. Kremers, of Milwaukee, is president of the company.

WATERTOWN, WIS.—Plans are being prepared by the Milwaukee Light, Heat & Traction Company for the construction of a power house at Watertown to furnish electricity to operate the electric railway now under construction from this city to Oconomowoc. The company has also decided to make improvements to the Rough and Ready Dam, which will include the raising of the dam, the erection of a new building and installing new machinery.

CALGARY, ALB., CAN.—P. A. G. Rodrique has applied to the City Council for a franchise for a street railway system.

CRANBROOK, B. C., CAN.—It is stated that capital has been secured for the Bull River Power & Light Company, which proposes to develop 10,000 horse-power on the Bull River near Cranbrook.

LADYSMITH, B. C., CAN.—The Council has decided to introduce a by-law providing for the sale of $25,000 in debentures for the purpose of building a municipal electric lighting system. Address Mayor Nicholson.

NEW WESTMINSTER, B. C., CAN.—J. Buntzen, managing director of the British Columbia Electric Street Railroad Company, states that the company will rebuild the Coquitlam Dam.

SELKIRK, MAN., CAN.—The Town Council has decided to purchase the electric plant of the Selkirk Electric Light & Power Company.

WINNIPEG, MAN., CAN.—The city solicitor has received word from the Ottawa Government to the effect that a lease will be given the city for the power plant site at Lac du Bonnet, and later the Government will give a title for the property. Cecil B. Smith is civic power expert.

FERGUS, ONT., CAN.—A rural telephone company is being formed to install a local telephone system to connect with the towns of Eramosa, Nichol and Larafrade. J. C. Templin is interested in the project.

GLENCOE, ONT., CAN.—A municipal electric lighting plant will be installed here. George Wilson is clerk.

NORTH BAY, ONT., CAN.—The North Bay Electric Light, Heat & Power Company offers to supply electric energy at 12 cents per kw-hour. Certain reductions are offered for prompt payments and no competition, which brings the rate down to 10¾ cents per kw-hour.

RAINY RIVER, ONT., CAN.—The International Rainy River Telephone Company contemplates several extensions this summer and the installation of a local system at Emo.

TORONTO, ONT., CAN.—The Weber Gas Engine Company, of Kansas City, Mo., has submitted a proposition to the Board of Control for the installation of producer gas plants. It claims to be able to generate electricity at about $8 per horse-power per year, and wishes to install various central stations of from 500 to 2000 horse-power in the factory districts.

MONTREAL, QUE., CAN.—The Montreal Southern Counties Electric Railway Company will soon commence the construction of the St. Lambert section at Montreal South and at Longueuil. The contract for marine cables across the Lachine Canal was awarded to the United States Steel Corporation.

INDIAN HEAD, SASK., CAN.—The citizens on April 13 voted in favor of issuing $10,000 in debentures, the proceeds to be used for extensions to electric light plant.

LANG, SASK., CAN.—Plans are being considered for the organization of a rural telephone company. C. W. Franks is the promoter.

MOOSEJAW, SASK., CAN.—The City Council has decided to return the tenders for the 500-kw generating unit and call for new tenders, to be opened May 17. John D. Simpson is city clerk.

HONOLULU, HAWAII.—The directors of the Hawaiian Electric Company have decided to increase the output of its present plant.

TORREON, MEX.—Plans are being considered for the construction of a new electric railway in this city. Foon Chuck and Dr. Wong Lim are interested in the project. The company will be capitalized at $1,000,000.

## New Industrial Companies.

THE ELECTRIC EQUIPMENT COMPANY, of Los Angeles, Cal., has been incorporated, with a capital stock of $20,000.

THE ELECTRIC CLOCK COMPANY, of Baltimore, Md., has been incorporated with a capital stock of $40,000 by Charles H. White and others.

THE ELECTRIC MUSIC COMPANY has been incorporated with a capital stock of $100,000, by I. W. Goodhue, M. Eisner, of New York, N. Y., and M. L. Blake, of Brooklyn, N. Y.

THE LEGNARD BROTHERS COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $5,000, by H. M. Legnard, B. L. Steele and A. B. Legnard. The company proposes to manufacture gas and gasoline engines.

THE PROTECUS ELECTRICAL MANUFACTURING COMPANY, of Pittsburg, Pa., has filed articles of incorporation with a capital stock of $125,000. The incorporators are: E. L. Kern, J. K. Neagley, and N. F. Bicking, all of Pittsburg, Pa.

THE HERCULEVEN COMPANY, of New York, N. Y., has filed articles of incorporation with a capital stock of $50,000, for the purpose of manufacturing motors, engines, cars, boats, etc. The incorporators are: Fred K. Felt, of Brooklyn; E. B. Goding and Sharon Graham, of New York, N. Y.

THE ATWOOD-REARICK COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, by George D. Atwood, L. R. Atwood, of Brooklyn; Charles B. Rearick and A. J. Rearick, of New York, N. Y. The company proposes to do an engineering and contracting business.

THE EXCEL ELECTRIC HEATING COMPANY, of Newark, N. J., has been incorporated with a capital stock of $40,000 by Richard W. Osland, Plainfield, N. J.; Edgar B. Drake, of Newark, N. J., and Edwin G. Russell, of Brooklyn, N. Y. The purpose of the company is to manufacture electric appliances.

THE FRANK L. PATTERSON & COMPANY, of New York, N. Y., has been incorporated with a capital stock of $20,000, by Frank L. Patterson, Arthur B. Grant, of New York, N. Y., and Isaac M. Patterson, of Trenton, N. J. The company proposes to manufacture heating apparatus, steam, electrical and hydraulic machinery, etc.

THE STANDARD JEWELLED BEARINGS COMPANY, of New York, N. Y., has been incorporated with a capital stock of $5,000, for the purpose of manufacturing jewels for electrical and mechanical purposes. The incorporators are: William Houser, of New York, N. Y.; Catherine F. Calahan, of Brooklyn, N. Y., and Louis S. Levy, of New York, N. Y.

THE INTERNATIONAL TRACTION & POWER COMPANY, of Philadelphia, Pa., has been chartered with a capital stock of $5,000,000, and proposes to erect a large plant on the Delaware River in or near Philadelphia, for the purpose of manufacturing engines for railway cars, automobiles, omnibuses, etc.; also full equipment for railway systems. The company will take over the auto car system of John C. Reuter, as well as the exclusive use of his crank engine for stationary engines, trucks, railroad cars and automobiles in United States, Mexico and Canada. The incorporators are: Carl M. Gage, J. A. Pfout, Thomas F. Deegan, all of Philadelphia; J. C. Reuter, J. C. Eccleston, of New York, N. Y., and S. V. Wardell, of Kansas City. Carl M. Gage will be president of the company.

## Company Elections.

COLUMBUS, GA.—At the annual meeting of the Columbus Automatic Telephone Company the following named officers were elected: J. A. Hart, president; Rhodes Browne, vice-president; F. R. Quayles, secretary and treasurer.

CHICAGO, ILL.—The Chicago Railways Company has completed its reorganization by the election of a new board of directors. Henry A. Blair was elected chairman of the board, and the other directors are: John M. Roach, Frederick H. Rawson, W. M. Eisendrath, Hempstead Washburne, A. B. Jones, J. W. Gary and Wallace Heckman.

LINCOLNVILLE, ME.—At the annual meeting of the Lincolnville Telephone Company the following named officers were elected: J. S. Mullin, president and manager; A. S. Young, vice-president; A. W. Knight, treasurer.

PENN YAN, N. Y.—At the annual meeting of the Yates County Telephone Company the following named officers were elected: C. E. Guile, president; Fred Culver, vice-president; David Miller, secretary, and F. E. Spencer, treasurer.

SPRINGFIELD, OHIO.—At the annual meeting of the Springfield & Xenia Telephone Company the following named officers were elected: J. L. Bushnell, president; J. F. McGrew, vice-president; Delos O'Dell, secretary and general manager, and R. R. Mills, treasurer.

PORTLAND, ORE.—At the annual meeting of the Portland Home Telephone Company the following named officers were elected: B. L. Willis, president; I. N. Fleischner, vice-president; A. A. Andrews, secretary and treasurer.

## New Incorporations.

DOUGLASS, ARIZ.—Articles of incorporation have been filed for the Cochise County Electric Railroad Company, by James S. Douglas, W. H. Brophy, M. J. Cunningham, M. J. Brophy and George H. Neale. The company is capitalized at $500,000, and proposes to construct an interurban traction line from Bisbee to Douglass.

REDLANDS, CAL.—The Standard Gas & Electric Company recently filed articles of incorporation here. It is capitalized at $50,000, has its principal place of business at Los Angeles and the directors are: Walter S. Cramp, Horace Slater and R. J. Dunn.

WILMINGTON, DEL.—The Mexican Electric Power & Tramway Company has been incorporated with a capital stock of $500,000.

WILMINGTON, DEL.—The Landers Power Company has been incorporated, with a capital stock of $100,000, by F. M. Shive, S. E. Roberson and Harry W. Davis, of Wilmington.

WILMINGTON, DEL.—Articles of incorporation have been filed for the Eastern Oregon Power Company, by S. B. Merrick, of Ivy, Va.; F. A. Bingham, of Chicago, Ill., and H. W. Davis, of Wilmington.

MULBERRY, FLA.—The Mulberry Electric Company has been incorporated with a capital stock of $4,000. The officers are R. H. Pratt, president and general manager; O. O. Hubbard, vice-president, and A. B. Hull, Jr., secretary and treasurer.

DAMASCUS, GA.—The Laurel Railway Company has been chartered with a capital stock of $10,000 to construct a five-mile road in Washington County. The officers of the company are A. A. Mock, of Damascus, president; G. W. Clements, of New York, N. Y., vice-president; F. G. Clements, of New York, N. Y., treasurer, and B. W. Mock, of Damascus, secretary.

BELLEVILLE, ILL.—The Alton, St. Louis & Cairo Electric Railway has filed articles of incorporation with a capital stock of $100,000. The directors are Thomas N. Chase, D. W. Young, J. F. Albrecht, Frank E. Orvis, William L. Ensel, B. L. Renfrow, E. L. Cragen, George M. Switzer and William R. Brown.

CHAMPAIGN, ILL.—The Somer Township Telephone Company has been incorporated, with a capital stock of $8,000, by O. B. Flatt, M. C. Busey and P. P. Dunn.

CHICAGO, ILL.—The Woodstock & Sycamore Traction Company has been chartered with a capital stock of $1,000,000, by Clinton G. Lumley, E. C. Spinney, Irving V. Stephens, E. B. Harang, S. H. Rhodes, William L. Abbott and others.

FALL CREEK, ILL.—The Fall Creek & Payson Telephone Company has been incorporated, with a capital stock of $1,380, by C. Fred Reinebach, William H. Watson and John C. Thompson.

MARISSA, ILL.—The Short Line Telephone Company has filed articles of incorporation with a capital stock of $150. The incorporators are: Philip Krebs, Otto Ochs and Gustave Kunze.

PIPER CITY, ILL.—The Piper City Telephone & Telegraph Company has been incorporated, with a capital stock of $10,000, by James P. Glass, W. H. Roberts and J. A. Montelius.

SHELBYVILLE, ILL.—The East Salem & Shelbyville Mutual Telephone Company has been chartered, with a capital stock of $1,050, by D. Y. Milligan, Simon J. Kensil, Jonas Strobe and others.

BEDFORD, IND.—The Bedford Power Company has filed articles of incorporation. The capital stock is $50,000. The object of the corporation is to construct a dam in White River and build a power plant to generate electricity, which will be transmitted to towns and cities. H. A. Mansfield, James B. Nelson, Harry S. New, S. A. Tescher and J. W. Holtzman are the incorporators.

FRANKFORT, IND.—The Indianapolis, Frankfort, Delphi & Chicago Traction Company has been incorporated, with a capital stock of $100,000. The company will succeed the Frankfort, Delphi & Northern Traction Company, incorporated last year to build an interurban and street railway from Frankfort to Hammond by the way of Delphi and Monticello. The company will improve the water power at Monticello, which will be used to generate electricity to operate the railway system and for lamps and motors.

GOLDSMITH, IND.—Articles of incorporation have been filed for the Goldsmith Co-operative Telephone Company with a capital stock of $10,000, by A. H. Hinkle, W. F. Cole, E. W. Allen and James Kessler.

NEW MARION, IND.—The New Marion, Rexville & Graff Telephone Company has been chartered for the purpose of constructing and operating a telephone system in New Marion and Ripley Counties. The directors are: B. D. Sands, W. W. McCoy and J. F. Holzer.

SOUTH BEND, IND.—The South Bend & Logansport Railway Company has filed articles of incorporation with the Secretary of State to construct and operate a street and interurban railway from South Bend to Logansport, a distance of 70 miles. The incorporators are Alexis Coquillard, Thomas P. Moredock, H. C. Onell and R. J. Hanlihan.

AMES, IA.—The Iowa Railroad Company has filed articles of incorporation with the Secretary of State. The company proposes to construct an electric railway from Waterloo to Perry, via Story City and Ames, where it will connect with the Des Moines & Fort Dodge Electric Railway. The officers of the company are: Henry S. Osborne, president; James F. Hardin, of Eldora, vice-president and treasurer, and George W. Scott, of Chicago, Ill., consulting engineer.

MUSCATINE, IA.—Articles of incorporation have been filed for the Evergreen Rural Telephone Company. The company is capitalized at $400, and the officers are: J. F. Maurer, president; J. W. Miller, vice-president; F. A. Duffer, secretary, and W. F. Marolf, treasurer.

PORTLAND, IA.—Articles of incorporation have been filed for the Portland Center Telephone Company, with a capital stock of $9,990, by A. H. Bauer, George Steiner, Charles W. Rippert, Jacob Bauer, E. A. Krause and others.

VALENCIA, KAN.—The Topeka & Valencia Toll Line Company has been organized and the following named officers elected: F. A. Keine, president and W. M. Purdy, secretary. The company proposes to erect a full copper circuit between Topeka and Valencia; also to erect another line from Auburn to Richland and other points in the southeastern part of the county.

HARLAN, KY.—The Pennington Gap Telephone Company has been organized by George W. Green, Henry Green and H. L. Howard. The company is capitalized at $3,000, and proposes to construct a telephone line from Harlan, via Rose Hill to Pennington Gap, a distance of about 20 miles.

HAZARD, KY.—The Hazard-Hyden Telephone Company has been organized, with a capital stock of $4,000, for the purpose of constructing an independent telephone system from Hazard, via Cornettsville to Hyden, a distance of 40 miles. The incorporators are: D. Y. Combs, of Hazard, and others.

ONO, KY.—The Ono Telephone Company has filed articles of incorporation with a capital stock of $500. The incorporators are W. S. Hughes, T. G. Smith and D. G. Coffee.

FARMINGTON, MAINE.—Articles of incorporation have been filed for the Rangeley Light & Power Company with a capital stock of $10,000. The officers of the company are D. D. Elliot, of Monmouth, president, and H. A. Furbich, of Rangeley, treasurer and clerk.

LEIGHTON, MICH.—The Leighton Farmers' Telephone Company has been organized and the following-named officers elected: Robert Smith, president, and J. F. Steeby, secretary and treasurer.

CLARA CITY, MINN.—The Northern Farmers' Telephone Company has been incorporated, with a capital stock of $20,000, by John Weeland, C. Busch, E. Miller, H. Worringer, E. Steffens, L. Gerdes and W. F. Reiner.

CLARA CITY, MINN.—Articles of incorporation have been filed for the Rheiderland Telephone Company, with a capital stock of $10,000, by J. F. Kray, Henry Fokkem, J. W. Caspers, George Van Hoven, E. J. Peterson, T. A. Hoff and A. Skonborg.

MAPLETON, MINN.—The Medo Central Telephone Company has been organized for the purpose of building and operating a telephone line to the new town of Pemberton. The officers of the company are: George Hussey, president; W. B. McKibben, vice-president; J. E. Anderson, secretary, and Jacob Groll, treasurer.

OWANTONNA, MINN.—The Lemond Rural Telephone Company has been organized and the following named officers elected: C. A. Tincher, president; A. Christianson, vice-president; Haldor Paulson, secretary, and W. W. Day, Jr., treasurer.

WADENA, MINN.—The Menahga Telephone Company has been incorporated, with a capital stock of $5,000, by P. McCoy, J. F. Ericson, W. H. Miller and others.

IBERIA, MO.—Articles of incorporation have been filed for the Iberia Mill & Electric Light Company with a capital stock of $9,000, by M. J. Davidson, J. S. Casey, J. L. Irwin and others.

ALDER, MONT.—The Ruby Valley Telephone Company has been organized, with a capital stock of $5,000. The officers of the company are: Frank S. Metzel, president; C. H. Bufford, vice-president; W. C. Metzel, secretary and treasurer.

BOZEMAN, MONT.—Articles of incorporation have been filed for the Hallatin Valley Electric Company, by W. S. Hartman, C. D. Hartman, of Bozeman, and W. H. Winfree, of Spokane. The company proposes to construct an electric railway 26 miles long, from Bozeman into the agricultural sections.

NORFOLK, NEB.—The Grant-Bell Telephone Company has been incorporated here and the following named officers elected: Henry Ertzner, president; G. Wagner, vice-president; Robert Pribnow, secretary and treasurer.

ROY, N. M.—The Roy Telephone Company, which has obtained a 50-year franchise to install a telephone system in Precinct No. 22, will file articles of incorporation under the territorial laws. The company also plans to establish long-distance service with Springer. A. S. Bushkevitz, Frank A. Roy, E. P. Brown and F. S. Brown are interested in the company.

ALBANY, N. Y.—Articles of incorporation have been filed for the Champlain & Sanford Railroad Company, with a capital stock of $600,000. The company proposes to operate a steam or electric railway from Addison Junction to Sanford Hill, a distance of 18 miles.

CHATEAUGAY, N. Y.—The Chateaugay Telephone Company has filed articles of incorporation with a capital stock of $2,000 with the following directors: M. J. McCoy, Charles H. Keefe, John G. Wells, Nathan A. Douglass, W. H. Thompson, Henry B. Smith and Herbert T. Earl.

SAND LAKE, N. Y.—Articles of incorporation have been filed for the Crystal Lake Home Telephone Company with a capital stock of $10,000. The directors are: Edward L. Grawelm, W. Lewis Burk, John M. O'Donnell, of Troy; William Eckes, of West Sand Lake, and Samuel McNay, of Sand Lake.

BROCKET, N. D.—A farmers' telephone company is being organized in this city. Fred Lemke is interested in the enterprise.

EMERDO, N. D.—A telephone company is being formed in this city to install a local system. John Hempstead is interested in the project.

MINOT, N. D.—The Berthold Telephone Company has been incorporated with a capital stock of $35,000 by T. F. Russel, C. D. Aaker and S. A. Finberg, all of Minot.

SHERWOOD, N. D.—The Whitney Farmers Telephone Company has been incorporated, with a capital stock of $6,050, by W. D. Brown, Thomas Spain, E. Quanstrum and others, all of Sherwood.

CLEVELAND, OHIO.—The Excelsior Electric Company has been incorporated with a capital stock of $10,000, by Fred Desberg, O. N. Smith, F. A. Waddell, Annette Newman and L. S. Desberg.

GOSHEN, OHIO.—The Wayne & Goshen Telephone Company has been incorporated with a capital stock of $2,500, by W. R. King, J. F. Shry, M. D. Frazier and others.

HARDIN, OHIO.—The Mutual Telephone Company has been organized to operate a telephone system in Shelby County and will connect with the long distance lines of the Central Union Company.

RICHMOND, OHIO.—The Farmers Telephone Company has been organized and the following named officers elected: N. L. Meffitt, of York, president; Charles M. Van Hyning, of East Liberty, vice-president; B. Jolliff, of Lunda, secretary, and J. C. Thomas, of Lunda, treasurer.

WARREN, OHIO.—The Hydro Electric Company has been incorporated, with a capital stock of $100,000, by C. M. Wilkins, O. D. Morgan, D. E. Hoover, C. K. Siegfried and Henry Herbert.

LONE WOLF, OKLA.—The New State Mutual Telephone Company has filed articles of incorporation, with a capital stock of $5,000. The directors are Charles Patterson, Joseph Altriger and W. E. Hunt.

MAY, OKLA.—The May Springs Telephone Company has been incorporated with a capital stock of $2,000, by T. J. Sewar and others.

MAYSVILLE, OKLA.—The Oklahoma Telephone, Electric Light & Power Company has been incorporated with a capital stock of $20,000 by A. P. Cash, Joseph Keller and others.

OKLAHOMA CITY, OKLA.—The Oklahoma-Shawnee Interurban Company has been chartered with a capital stock of $300,000, by H. M. Wyatt, A. M. Spencer, Stephen Brown, Joseph Brown and J. A. Stevenson, all of Oklahoma City.

WEATHERFORD, OKLA.—The Federal Telephone Company has filed articles of incorporation. The capital stock of the company is placed at $5,000, and the directors are C. E. Huber, E. DeWitt and H. H. Curry, all of Weatherford.

PORTLAND, ORE.—Articles of incorporation have been filed for the Valley Power Company by Frank Robertson, Charles H. Carey and William S. Turner, of Portland. The capital stock of the company is placed at $100,000 and it proposes to construct an electric railway from West Woodburn, three miles, and thence through Monitor to Scott Mills and on to Wilhoit Springs. Work on the construction of the road will begin about May 15.

COUDERSPORT, PA.—The Inter-ocean Telephone Company has been organized by John F. Stone, Frank Raymond and A. L. Curtis. The company proposes to construct a telephone line between Olean and Port Allegheny, work on which will soon begin.

WESTERLY, R. I.—The Ashaway & Westerly Railway Company has been organized and the following-named officers elected: A. B. Briggs, president; John W. Sweeney, vice-president, and Frank Hill, secretary and treasurer. The company has decided to have a preliminary survey made at once of the proposed road.

GREENVILLE, S. C.—The Greenville & Carolina Railway Company has been organized to build an electric railway from Greenville to Asheville, a distance of about 70 miles. The contract for the construction of the road will be let to the Carolina Construction Company, of Asheville. The company has purchased water-power rights and will develop 6000 horse-power. Work on the construction of the power plant will soon commence. The cost of the road is estimated at about $2,000,000. T. E. Smith, of Greer, is president, and L. W. Walker, of Hendersonville, secretary and treasurer.

WINFRED, S. D.—An Independent telephone company has been organized in this city, for the purpose of installing a local exchange and erecting a number of rural lines, work on which will commence at once.

DEFEATED, TENN.—Articles of incorporation have been filed for the Defeated Home Telephone Company with a capital stock of $500 by N. Cardwell, J. H. Dillaby, T. T. Kemp and N. B. West.

HICKMAN, TENN.—A charter has been granted to the Hickman Telephone Company, with a capital stock of $1,000. The incorporators are W. T. Jones, S. T. Tubbs, W. R. Agee, H. T. Moss and others.

HUMBLE, TEX.—The Mutual Telephone Company has been chartered with a capital stock of $4,000, by W. M. Abbey, F. M. Burton and J. E. Shankland.

ARLEE, W. VA.—The Mountain Rose Telephone Company has been incorporated, with a capital stock of $3,000, by J. M. Wallis, H. C. Bateman, Thomas Bateman, Mercers Bottom, Z. Plants, of Arlee, and Isaac Schloss, of Ino.

JUNEAU, WIS.—The Juneau Telephone Company has been incorporated with a capital stock of $10,000 by Peter Peters, Nathan Scott and A. McCollow.

OSHKOSH, WIS.—Articles of incorporation have been filed for the Little Wolf River Power Company with a capital stock of $250,000. The officers of the company are Leander Choate, president; Casper Faust, vice-president; Frank H. Joslyn, secretary, and E. H. Steiger, treasurer. The company owns water power rights on the Little Wolf River and proposes to erect a hydro-electric plant and furnish electricity in Oshkosh.

OWEN, WIS.—The Owen Telephone Company has been incorporated with a capital stock of $2,000 by H. C. Fickes, H. B. Crane and J. P. Weirich.

MALLORYTOWN, ONT., CAN.—Application has been made for a charter for the Mallorytown Independent Telephone Company by W. A. Lewis.

MILESTONE, SASK., CAN.—The Milestone Southwestern Telephone Company has been incorporated.

SEAFORTH, CAN.—The McKillop Telephone Company has been organized and the following-named officers elected: R. Scarlett, president, and James Kerr, secretary.

WAPELLA, SASK., CAN.—Articles of incorporation have been filed for the Wapella-Harris Telephone & Supply Company.

MORELIA, MEX.—The Compañia de Telefinos Comerciales has been organized at Morelia, state of Michoacan, for the purpose of installing a telephone system in this city and the neighboring towns of Uruapan and Tacambaro. The incorporators are: Antonio Gutierrez, Balbuena; Enrique Arreguin and L. E. Suzan. A. B. Adams, of New York, N. Y., F. Holbrook and W. S. Patton, of Boston, Mass., who hold concession from the Mexican Government for the building of long-distance telephone lines in the state of Vera Cruz, are interested in the project.

## *Legal.*

RIGHTS TO A RIVER CURRENT.—The United States Circuit Court of Appeals at San Francisco has affirmed the decision of the Idaho court in the case of Henry Schodde against the Twin Falls Light & Water Company. Schodde had been using the waters of Snake River in Idaho for the irrigation of his property and alleged that the subsequent building of the dam of the defendant company and the consequent impounding of the water deprived him of the use of his irrigation plant. He therefore asked for $56,650 damages. The lower court decided that the plaintiff did not own the current of the stream, as he claimed, therefore he had no cause for action against the defendant.

SUIT TO PREVENT THE PURCHASE OF NEW EQUIPMENT.—Suit has been entered by injunction proceeding in the Common Pleas Court of Ohio against the Mansfield Light & Power Company to prevent the purchase of new equipment amounting to $100,000. The plaintiffs claim that the omission of the preferred stock dividend in February was made to secure additional funds for improvements, in order to supply power for the Ohio Central Traction Company and other interurban lines. The action is taken to protect the credit of the company against contracts with the Westinghouse Electric & Manufacturing Company, with which negotiations had been in progress for equipment valued at from $70,000 to $90,000.

CONSTRUCTION OF FRANCHISE TO OPERATE TELEPHONE SYSTEM.—An action was brought against the city of Lathrop, Mo., to restrain that municipality from interfering with the plaintiffs in the work of erecting a telephone system. The plaintiffs were going ahead with the work under the assumed authority of a franchise which empowered them to erect, maintain and operate a telephone system. But it was shown that, by virtue of that franchise, the plaintiffs had purchased a telephone system already in operation. This was held to be an accomplishment of the purpose of the franchise, and the plaintiffs, having become the owner of one telephone system under the franchise, could not legally erect and operate another one thereunder. Ely v. City of Lathrop, Kansas City Court of Appeals, 107 S. W., 410.

INJUNCTION.—An injunction has been served on the Economic & Construction Company restraining them from placing its wires in the city conduits of Geneva, N. Y. The city officials were also served with papers restraining the city from permitting the new company to occupy the conduits. The papers were served by the Geneva-Seneca Electric Company, which alleges that the Economic Power & Construction Company has never obtained any right or privilege under any franchise granted by the city to furnish electricity in Geneva, except that of the Geneva Steam Heating Company, which it acquired by purchase. It further alleges that the defendant company is not authorized by law to carry on the business of electric lighting and has not secured the consent of the local municipal authorities to use the streets for electrical purposes; also that it has not made application to the Public Service Commission, nor has it obtained the permission and certificate from the commission, which would enable it to conduct such business as planned.

LIGHTING COMPANY NOT RESPONSIBLE FOR POOR INSULATION.—Judge Mumford, of the Superior Court, Providence, R. I., has filed a rescript in the suit of the Corliss Steam Engine Company vs. Narragansett Electric Lighting Company, of Providence, granting a decision for the defendant, with costs. The action was brought to recover the amount of two judgments against the Corliss Engine Company to recover damages for an accident which occurred at the company's works on Feb. 6, 1896, one in favor of William Moran, who was severely injured and awarded $1,500 and costs. William Houghton was killed on the same date, and his administratrix, Sarah C. Houghton, was awarded a verdict for $7,000 and costs. The plaintiff had in its foundry several jib cranes which were operated by electric motors. It was alleged that the electricity for operating the motors was supplied by the Narragansett Electric Lighting Company, under a contract to furnish the energy at 500 volts, and no more, and that on the day of the fatality the wire which transmitted the energy came in contact with a high-tension wire, which caused the machine to be overcharged. The Corliss Engine Company accordingly brought suit against the lighting company to recover for the two verdicts, on the ground that the real negligence was on part of the company furnishing the electricity. The court, however, found from the evidence that sufficient warning had been given the engine company of the fact that its machine was not properly insulated, and that even if the electric company was responsible for an unusual voltage on the wires, still it could not be held responsible for the accident, which could not have happened had the machine been in proper order.

CONCURRENT NEGLIGENCE OF TWO ELECTRIC COMPANIES.—In an action against an electric light company and a telephone company it was claimed that the two companies were jointly liable for the death of a person which resulted from a dangerously charged guy wire. It was shown that the telephone company had attached a guy wire to the top of a pole belonging to the electric light company and had allowed the guy wire to rest upon the electric light wires attached to the pole and hang down into the street. The electric light wires, not being properly insulated, the broken guy wire became charged and caused the death for which the action was brought, when the deceased leaned against the pole and touched the wire in so doing. It was held that both companies were guilty of negligence, the telephone company by reason of its act in attaching the guy wire and allowing it to remain in a dangerous position, and the electric light company by reason of its failure to remove the wire. On

behalf of the electric light company it was argued that the other defendant was the active wrongdoer, and that its own negligence, if any, was, in a sense, passive. Conceding this to be true, it was said by the court: "The fact that the guy wire was permitted to remain in contact with the post, so that a bystander in placing his hand against the post, might touch the wire, was the essential element of negligence in this case, and the testimony shows that both defendants were responsible for that fact. If the telephone company had not connected the wire with the post, it never would have been there; and, if the electric light company had not been guilty of negligence in their failure to remove it, it would not have been there when Compton placed his hand against the post. In reference to that guy wire, the law imposed certain duties upon each company; and, if either had performed its duty, Compton would not have been hurt. The telephone company committed a negligent and wrongful act when it attached the guy wire to the post; and if it had not done so, no injury would have been sustained. The electric light company was guilty of negligence in failing to remove the wire from the post." San Marcos Electric Light & Power Company v. Compton, Court of Civil Appeals of Texas, 107 S. W., 1151.

## Personal.

MR. JAMES R. LEAGUE has been appointed general manager of the Augusta Railway & Electric Company, of Augusta, Ga.

MR. TEISHIRO OTAKI, of the municipal electric works, Kyobo, Japan, is on a visit to this country, during which he will inspect some of our more important power stations and hydro-electric plants.

MR. TIMOTHY L. LYNCH has been appointed manager of the municipal electric light plant of Danvers, Mass. Mr. Lynch has been one of the electric light commissioners for some time and is familiar with the plant.

MR. T. C. ROBERTS., master mechanic of the American Smelting and Refining Company's Pueblo plant, has been appointed superintendent of power and shops for the Pueblo and Suburban Traction & Lighting Company, Pueblo, Col.

MR. ROSCOE HOWARD, of Tacoma, Wash., has been appointed general manager of the Deschutes Irrigation & Power Company, of Bend, Ore., to succeed Mr. F. S. Stanley, who is now first vice-president of the company. Mr. Howard will make his headquarters at Bend.

MR. EDWARD B. MERRILL, formerly chief electrical engineer of the Winnipeg hydro-electric power scheme, has opened offices in Winnipeg, Man., Can. He will make a specialty of power developments, electric railways and lighting and municipal engineering.

COL. C. A. BOYNTON, superintendent of the Southern division of the Associated Press, has had conferred on him the decoration of the fourth class of the Imperial Order of the Rising Sun as a token of the high esteem for him entertained by the Emperor of Japan and as a mark of appreciation of his services.

MR. E. W. MUZZY, for the past seven years apparatus salesman for the General Electric Company, has resigned to become vice-president and sales manager of the Spencer Turbine Cleaner Company, Hartford, Conn., manufacturer of vacuum cleaning apparatus. Mr. Muzzy enjoys the very high esteem of his old associates and executive chiefs.

GEORGE H. SHUMAN, contracting electrical engineer, has disposed of his interest in the E-J Electric Company to the other members of the firm. Mr. Shuman will continue in the electrical contracting business at the same address, 15 East Thirtieth Street, New York, and Mr. N. C. Solomon, consulting engineer, will superintend and direct the work.

MR. J. F. GEISER, formerly superintendent and electrical engineer of the Waynesboro Electric Light & Power Company and the Chambersburg & Waynesboro Street Railway Company, of Waynesboro, Pa., has severed his connection with the above companies and has entered the field of kinetic engineering as consulting engineer. Mr. Geiser has opened an office in Waynesboro, Pa.

MR. L. R. McBROON, who has been connected with the General Electric Company, of Schenectady, N. Y., has been appointed general superintendent of the Rutland Railway, Light & Power Company, of Rutland, Vt. Mr. McBroon is to have charge of the operating and street railway departments, succeeding Mr. Henry W. Brow, electrical engineer, and Mr. W. H. Horton, superintendent of the street railway, recently resigned.

PROF. W. KENT.—A special dispatch from Syracuse, N. Y., of April 22 says: "Acting in accordance with the wishes of Chancellor James R. Day, the executive committee of the board of trustees of Syracuse University have voted not to retain Mr. William Kent as Dean of the College of Applied Science. This decision becomes operative if ratified by the board of trustees at their June meeting, which will be presided over by Mr. John D. Archbold, of New York. Chancellor Day is said to have requested this action on the part of the executive committee on the ground that the Dean had, during the Chancellor's absence in New York recently, overstepped his authority in making inspections of the university buildings in order to prevent a recurrence of any such disaster as the Collinwood fire."

MR. HORATIO A. FOSTER, resident engineer in Baltimore, Md., for L. B. Stillwell, has been transferred to the New York office, 100 Broadway, joining the forces at that point. He will still continue to look after the work in Baltimore, spending such time there as may be necessary, sharing this supervision with Mr. H. S. Putnam on electrical work and with Mr. Van Vleck on the steam end. Mr. Foster has been in charge of the work in Baltimore since it was started, a year and a half ago, and has carried through to completion the many additions and changes made to the power plants of the United Railways & Electric Company, under the contract with Mr. Stillwell. These included the construction of a power station at Bay Shore, a new summer resort; a new substation in the central part of the city; an addition to one of the outlying substations; rearranging and reinforcing of three existing substations, and the construction and reconstruction of the Pratt Street power station. During this period of building the operation of all power plants came under his supervision, and the forces were all thoroughly reorganized.

## Obituary.

MR. SIDNEY ADLER, an electrical engineer, of Philadelphia, Pa., died April 15 in the German Hospital following an operation. He was 23 years of age and a graduate of the Sheffield Scientific School of Yale University, New Haven, Conn., in 1905.

MR. EUGENE MUNSELL, president of the Mica Insulator Company, New York, met sudden death last week by jumping from a window of his apartments at the Hotel Van Dyke, New York. Ill health of long duration is said to have led him to commit the act. Deceased was 56 years of age, and came from a family long connected with the American stove industry. He was a man of culture, traveled considerably and was a lover and purchaser of works of art.

MR. CHARLES H. NEWHALL, president of the Lyon Gas & Electric Light Company, of Lynn, Mass., died at his home April 22. He was 62 years old. Mr. Newhall had been president of the Lyon Gas & Electric Company for 25 years. He was a director of the old Thomson-Houston Electric Company, which later was merged with the General Electric Company, and was one of those instrumental in bringing that plant to Lynn in 1888. He was also vice-president of the Central National Bank and a director of the Security Safe Deposit & Trust Company, a member of the investment committee of the Lynn Five Cents Savings Bank, a trustee of the Lynn Public Library and a prominent member of the First Unitarian Church.

## Removals.

THE WELLMAN-SEAVER-MORGAN COMPANY has moved its New York office to the Hudson Terminal, 50 Church Street.

THE BALL & WOOD COMPANY has moved its sales office to 1422 Cortlandt Building, Hudson Terminal, 30 Church Street, New York.

THE POWER AND MINING MACHINERY COMPANY has removed its San Francisco office from 148 First Street to Room 217, Sheldon Building.

J. G. ROSSMAN, consulting engineer, who makes a specialty of the development and reorganization of water-power, lighting and traction properties, has removed his offices from 80 Wall Street to 140 Nassau Street (P. O. Box 1565), New York.

THE JENNEY ELECTRIC MANUFACTURING COMPANY, of Indianapolis, Ind., has decided to remove its manufacturing plant from this city to Anderson. It is understood the company is a beneficiary of the big factory fund recently raised in Anderson. A site is also to be donated.

THE EMERSON ELECTRIC MANUFACTURING COMPANY has moved its New York office from 136 Liberty Street to much more convenient and commodious quarters on the fourteenth floor of the new Hudson Terminal Building, 50 Church Street, from which office the company will be able to give its customers improved service.

THE GREGORY ELECTRIC COMPANY, of Chicago, will be represented at the convention of the National Electric Light Association at the Auditorium, Chicago, and will have an exhibit in space No. 5. Representatives of the company will welcome its patrons at the convention, and a cordial invitation is extended to all visitors to inspect the company's new works.

THE ELECTRIC SERVICE SUPPLIES COMPANY has moved its offices from the United States Express Building, 2 Rector Street, to the eighteenth floor of the Hudson Terminal Bldg., 50 Church Street, New York. In the new location the offices are more commodious and a newly arranged sample room is being fitted out, and visitors will be cordially welcomed. The Pittsburg office of this company has also been removed from the Terminal Warehouse to the Farmers' Bank Building. A sample room has also been fitted up in this office.

N. E. L. A. EXHIBITION.—The Exhibition Committee of the National Electric Light Association reports that nearly all of the available exhibition space has been taken. The color scheme decided upon is a combination of a peculiar shade of dark green, and white containing a tinge of green. The lettering of the sign board will be in gold or aluminum. Additions to the list of those who will exhibit, which was printed in these columns last week, are the following: German-American Electric Company, Condit Electric Manufacturing Company and the Gregory Electric Company.

CROSBY, CRAFT & COMPANY, 723 Williamson Building, Cleveland, O., have recently taken the agency for the State of Ohio for the Hartman Circuit Breaker Company, manufacturers of oil switches, circuit breakers

and transformers. Crosby, Craft & Company are to make a specialty of instruments and circuit breakers, and, in addition to the Hartman line, they represent in Ohio the Whitney Electrical Instrument Company, the Sangamo Electric Company, Machado & Roller and the Switchboard Equipment Company. This concern is under the management of Mr. G. L. Crosby, who for several years has made a specialty of circuit breakers and instruments in the territory in which he is now located.

THE OHIO BRASS COMPANY, whose main offices and works are located at Mansfield, Ohio, will, on May 8, move its New York offices from their present location in the Wall Street Exchange Building, 43 Exchange Place, to Room 1022 of the new Cortlandt Building, Hudson Terminal, with entrances at 32 Cortlandt Street and 30 Church Street. The telephone number in the new quarters will be 6658 Cortlandt. On May 1 the Chicago office of the same company was removed to the Fisher Building, corner Dearborn and Van Buren Streets, just one block north of the present location, at 321 Dearborn Street. The present telephone number, Harrison 4344, will be retained in the new quarters. The new location is very conveniently situated with respect to the leading hotels, and within a few minutes' ride of all railway depots. A "loop" station, at which all elevated trains stop, is located at this corner.

## Trade Publications.

CREDIT.—The E. Bissell Company, Toledo, Ohio, is sending out in neat pamphlet form, a reprint of an article entitled "Credit," written by Col. W. C. Hunter, which points out how essential a factor credit is in building up a business, and also how essential truth is in building up credit.

WIRES AND CABLES.—The Habirshaw Wire Company, 253 Broadway, New York City, has just issued a new and complete catalogue and price-list of its wires and cables. This catalogue includes all the variety of product in different lines, and gives a full set of prices with copper from 12 cents up to 25. It contains also a good deal of other useful data and information. It is a valuable handbook for the trade, and copies can be had on application.

GRAPHITE BRUSHES.—The April issue of *Graphite*, the monthly publication of the Joseph Dixon Crucible Company, Jersey City, N. J., contains an article pointing out the advantages of graphite dynamo brushes.

VACUUM APPARATUS.—Catalogue No. 8, of the Alberger Condenser Company, 95 Liberty Street, New York, deals with Alberger high-vacuum apparatus especially adapted to vacuum pans, multiple effects, evaporators and stills.

ELECTRIC MEASURING INSTRUMENTS for direct and alternating-current circuits, in both portable and switchboard types, are described in a well-illustrated 64-page catalogue issued by the International Electrical Meter Company, Chicago, Ill.

HIGH-TENSION CIRCUIT BREAKERS.—J. H. Kelman, 1000 N. Main Street, Los Angeles, Cal., has issued folder No. 3, calling attention to his oil-immersed automatic circuit breaker for electromotive forces of from 15,000 to 100,000 volts.

GAS ENGINES.—An artistic catalogue has been issued by the National Meter Company, 84 Chambers Street, New York, is devoted to a description of Nash gas and gasoline engines for electric lighting, pumping, fire protection and industrial purposes generally.

ARC LAMPS.—Bulletin No. 32A, of the Helios Manufacturing Company, 18 East Forty-second Street, New York, describes series alternating-current arc-lighting systems. Information is given concerning lamps, constant-current regulators, insulating transformers and connecting circuits.

POWER EQUIPMENT FOR CEMENT MILLS.—Bulletin No. 5910 of the Western Electric Company has for its subject the electrical power equipment of cement mills. A number of excellent engravings show equipment of this kind installed by the Western Electric Company in a number of mills.

ELECTRIC FANS.—Bulletin No. 1105 of the Fort Wayne Electric Works, Fort Wayne, Ind., gives a complete description of direct-current and alternating-current fans. A commutator type of motor is used with direct-current and 60-cycle fans, while a self-starting shaded-pole induction motor is used with 140-cycle fans.

MAGNETO TELEPHONES.—The Stromberg-Carlson Telephone Mfg. Company has issued an eight-page pamphlet preparatory to the issue of a bulletin descriptive of the Stromberg-Carlson "Mine-a-Phone" system, which describes and illustrates by means of five different views a new type (No. 890) of iron-clad magneto telephone.

RECORDING INSTRUMENTS.—Vol. 1, No. 1, of "The Recorder," published by the Bristol Company, Waterbury, Conn., has reached us, dated March, 1908. This magazine is being issued as a house organ in an effort to shed light upon the subject of recording instruments and their applications. The magazine is being distributed free of charge to those interested.

PORTABLE AIR COMPRESSORS.—Bulletin No. 1,512 of the Allis-Chalmers Company describes in detail, with illustrations, the portable air compressor of its manufacture. These compressors are built for capacities of 11, 16, 20 and 50 cubic feet of free air per minute. Each is constructed throughout with sufficient strength to withstand a working pressure of 100 lb. per square inch.

AN ELECTRICAL MENU.—At a dinner of the Trumbull Electric Manufacturing Company's forces at the Heublein, Hartford, Conn., on April 4, a very amusing menu card was employed based on the phraseology of the company's product, each item thus receiving a subtitle not unually recognized by the culinary art. There were also some humorous verses aimed at the factory staff and at the salesmen.

ELECTRIC SWITCH INDICATOR.—Among the special characteristic improvements to be found in the switch indicator, described in Bulletin No. 4563 of the General Electric Company, is a resistor having a resistance amounting to twice that of the operating coils. When the indicator is in the "clear" position, the resistor is placed in series with them, thereby reducing the power consumption by two-thirds.

FRANKLIN BULLETIN.—The Franklin Electric Manufacturing Company, Hartford, Conn., in its Bulletin No. 6 gives many interesting facts about its Franklin Gem, tantalum and tungsten lamps, and figures are submitted making a favorable showing for these lamps compared with carbon filament lamps of the same class. The bulletin, which has eight pages, is attractively gotten up and contains several interesting illustrations.

ISOLATED PLANT SWITCHBOARD PANELS.—The General Electric Company has issued Bulletin No. 4558, in which the equipment of isolated plant feeder panels and the combination generator and feeder panels are described, details of the instruments, circuit breakers, switches, mounting of rheostats, etc., are given, and the dimensioned drawings with diagrams of connections and tabulations of the various ratings included. The panels provide for controlling 125-volt generators rated at from 5 to 240 kilowatts, and 250-volt generators for from 10-kw to 240-kw rating.

PORCELAIN ELECTRICAL SPECIALITIES.—The E. H. Freeman Electric Company, of Trenton, N. J., has issued, in convenient form, a catalogue of its long line of porcelain electrical specialties, all of which are shown in illustrations. The Freeman Company has its own pottery, which enables it not only to control the grade of its material, but allows improvements to appliances to be readily made when these are indicated. Among its manufactures are complete lines of sockets, receptacles, rosettes, attachment plugs, plug cut-outs, fuse plugs, wiring-circuit fittings, porcelain knobs, tubes, etc.

TUNGSTEN LAMP FOR STREET LIGHTING.—Bulletin No. 4571 of the General Electric Company is devoted to the tungsten lamp as applied to street lighting. Data and prices, candle-power, distribution curves and illustrations of the lamp and ornamental brackets used in street lighting are given. The lamps are rated at an efficiency of 1¼ watts per candle-power with an estimated life of approximately 1000 hours. The ampere range of the various types of lamps is from 3.7 to 8 and the candle-power from 32 to 60. The 32-cp lamp has an average total watts of 40, and the 60-cp lamp of 75.

ASBESTOS WOOD.—The H. W. Johns-Manville Company, of 100 William Street, New York, has issued Catalogue No. 107, having for its subject "Asbestos Wood," a fireproof substitute for wood, slate, marble and fibre, for building construction and electrical installation. This material is the invention of Prof. Charles L. Norton, of the Massachusetts Institute of Technology. It is claimed that "ebony" asbestos wood is far superior to either slate or marble for electrical purposes, having much higher electrical resistance than either of these and being almost equal, in this respect, to hard rubber or sheet mica. One of the distinct advantages is that it may be worked almost as easily as ordinary wood.

RAILWAY SWITCHBOARDS.—Bulletin No. 4544, of the General Electric Company, Schenectady, N. Y., covers several classes of switchboard panels for 600-volt, direct-current railway service. The following types are described: Generator panels, including circuit breakers and equalizer switch panels, rotary converter panels, feeder panels for one circuit, feeder panels for two circuits with one ammeter per panel, and feeder panels for two circuits with two ammeters per panel. The various forms of apparatus used in connection with the panels, details of construction, etc., are described and illustrated, and complete tables containing catalogue numbers, ratings, etc., and dimension sketches are given.

ECONOMIZERS.—The Green Fuel & Economizer Company, Matteawan, N. Y., has issued a 66-page publication, which takes up not only the history and merits of its devices, but also such engineering topics as the absorption of heat by different parts of the boiler surface; the relative economy of boiler surface and economizer surface under various conditions, methods of determining the economy of additional heating surface from the load curve; the effects of oil fuel, high steam pressures and superheat on boiler economy; methods of measuring the temperature of flue gases; and reports of various tests of boiler plants containing economizers. The general scope of the whole may be inferred from the following chapter headings: The economizer and its inventor; elementary theory of the economizer; forcing capacity of boilers; profit from an economizer; secondary advantages of the economizer; the economizer in small boiler plants; calculating the performance of an economizer; simple method of figuring the saving; actual saving greater than theoretical saving; measuring the temperature of the flue gases; actual results obtained in economy tests of economizers; design and construction of the fuel economizer; waste-heat air heater; air heater and economizer in water-gas manufacture; chimneys, mechanical draft, steam and fan tables.

RADIATOR VALVES and union elbows are illustrated and described in Catalogue D, recently issued by the Ohio Brass Company, Mansfield, Ohio.

MOTOR EQUIPMENTS for boot and shoe factories are thoroughly treated in Bulletin No. 5910-2 of the Western Electric Company, Chicago, Ill.

LIGHTING SPECIALTIES are dealt with in an instructive manner in the April issue of "Paistery," published by the H. T. Paiste Company, Philadelphia, Pa.

PACKING.—Sheet and rope packing made of asbestos is treated in Folder No. 7705 of the H. W. Johns-Manville Company, 100 William Street, New York.

LAMP GUARDS.—"Never Break" lamp guards made of steel wire are thoroughly described in a 28-page booklet issued by the F. Bissell Company, Toledo, Ohio.

OUTLET BOXES.—Circular No. 428 of the Sprague Electric Company, 527 West Thirty-fourth Street, New York, is devoted to stamped steel outlet boxes and fittings.

BOILER-TUBE CLEANERS are listed in a leaflet devoted to the "National" steel cleaner issued by the H. W. Johns-Manville Company, 100 William Street, New York.

THE BISSELL FROG.—The F. Bissell Company, Toledo, Ohio, is issuing a series of souvenir post cards indicating that the "Bissell Frog" is on the way to visit a customer.

PANEL BOARDS for all kinds of electric lighting installations are dealt with fully in Bulletin No. 20 of the H. Krantz Manufacturing Company, 160 Seventh Street, Brooklyn, N. Y.

BELTED ALTERNATORS.—Polyphase belt-driven revolving-field alternators are described in detail and fully explained in Bulletin No. 1104 of the Fort Wayne Electric Works, Fort Wayne, Ind.

AIR COMPRESSORS of the motor-driven type for operating air brakes are treated in an instructive manner in Bulletin No. 384 of the National Brake & Electric Company, Milwaukee, Wis.

PANEL BOARDS.—A catalog recently issued by the Electric Manufacturing Company, 926 Lafayette St., New Orleans, La., gives a complete price list of panel boards, together with dimensional illustrations.

ELECTRIC FANS.—The "Standard" fan catalogue for 1908, published by The Robbins & Meyers Company, Springfield, Ohio, is an artistic production dealing with well-designed fans for direct-current and alternating-current circuits.

LOCOMOTIVE CRANES.—The Brown Hoisting Machinery Company, Cleveland, Ohio, has issued Bulletin K dealing with locomotive cranes for handling coal, ore, sand, ashes, etc. These cranes are operated by means of steam engines or electric motors.

VALVES.—Catalog 8, Section C, of the Schutte & Koerting Company, Philadelphia, Pa., contains illustrations and descriptions of extra heavy balanced valves of the stop and throttle types. Section D of the same catalog deals with balanced-trip and trip-throttle valves.

IGNITION BATTERY.—The Apple Electric Company, Dayton, Ohio, has issued Bulletin No. 1A devoted to portable storage batteries for automobile, motor boat and stationary gas engine electric ignition and lighting or for any purpose requiring direct current at low voltage.

SETTING CORLISS ENGINE VALVES.—The Allis-Chalmers Company have issued a pamphlet containing directions for setting the valves of the Reynolds heavy duty reliance Corliss engines, a copy of which will be sent upon application to those interested.

TUNGSTEN AND TANTALUM CLUSTERS.—The Federal Electric Company, of Chicago, has recently brought out some new clusters which are designed especially to take tungsten lamps. These are simple in construction and designed to meet the competition of gas and electric arcs. Its regular clusters are also suited to this use in a higher grade of work. Bulletin No. 80B describes the simpler clusters and No. 80 the regular clusters.

FORGE BLOWERS.—Bulletin No. 3305, of the Emerson Electric Manufacturing Company, St. Louis, Mo., is devoted to forge blowers direct-connected to alternating-current or direct-current motors. The direct-current motors are arranged for variable speed, but the alternating-current motors are of the constant speed type; when the latter motors are used blast gates are installed for regulating the flow of air and preventing waste of electrical energy.

LIGHTNING ARRESTERS.—Graded shunt resistance multigap lightning arresters are described in Bulletin No. 4573 of the General Electric Company. The bulletin also contains detailed descriptions of low-voltage arresters, static dischargers, constant-current horn arresters, disconnecting switches, choke coils and direct-current arrester for voltages up to 6000. Tables of general data regarding the apparatus, connection and dimension diagrams, etc., are included. The bulletin is bound in an artistic cover.

INSULATED STAPLES.—The Blake Signal & Manufacturing Company, 246 Summer Street, Boston, Mass., has issued a folder illustrating and describing the Blake insulated staple and compressed cleat. The insulation of the staple is of fibre so attached that it cannot come off in driving. The compressed cleats are used where staples cannot be employed; their advantages are less cost than fibre or porcelain cleats and ability to withstand the blow of a hammer, so that wire nails can be used as well as screws.

TUNGSTEN LAMP FOR STANDARD LIGHTING SERVICE.—Bulletin No. 4570, recently issued by the General Electric Company, Schenectady, N. Y., describes and illustrates the General Electric tungsten lamp for 100 to 125-volt circuits. The lamp is made in 40, 60 and 100 watts and has a life of approximately 800 hours when used on either alternating or direct current. Some of the illustrations show the tungsten incandescent units, combined with standard Holophane globes, which can be used to excellent advantage in this manner.

## *Unclassified Items.*

HOUGHTON, MICH.—Extensive improvements are contemplated this summer for the properties of the Houghton County Street Railway and the Houghton County Electric Light Companies, which will involve an expenditure of about $1,000,000. The more important work will include the six-mile extension to Mohawk; erection of a new substation at Larium; rebuilding of the overhead electric system at Calumet; new transmission line from Calumet to Mohawk to supply electricity for mines; enlargement of car barns at Larium and Hancock, and improvements to coal handling apparatus at Hancock and Houghton. Stone & Webster, of Boston, Mass., are managers of the companies.

HUDSON, WIS.—The interior of the substation of the local electric light system was destroyed by fire April 19, causing a loss of several thousand dollars. The lighting system will be crippled for several days.

MANITO, ILL.—The Village Board has voted to bond the town for $3,500 and assume control of the electric light plant, which was started by J. N. Smith. With the poles in place and part of the machinery installed work on the construction of the plant was stopped. The village will pay Mr. Smith about $1,600 for his interest and advertise for bids for the completion of the plant.

BROCKTON, MASS.—The Gas and Electric Light Commissioners have authorized the Edison Electric Illuminating Company of Brockton to issue $100,000 in bonds, the proceeds to be used to cancel outstanding promissory notes.

LOWELL, MASS.—The Lowell Electric Light Corporation has received permission from the State Gas and Electric Light Commissioners to issue $93,000 in additional capital stock at $150 per share, the proceeds to be used to cancel outstanding notes.

MEMPHIS, TENN.—The City Council is considering the question of installing a municipal electric light plant to cost $750,000. J. H. Weatherford is city engineer.

HAVERHILL, MASS.—The Haverhill Electric Company will soon commence work on the construction of its underground conduits on several streets in the city.

GREENWICH, CONN.—It is reported that the Westchester Electric Company contemplates extending its transmission lines to Greenwich to furnish electricity throughout the town, reaching to the Stamford boundary. The company's lines now extend to East Port Chester.

MANCHESTER, MASS.—The citizens are considering the proposition of purchasing the electric plant of the Manchester Electric Company, and have appointed a committee, consisting of E. S. Knight, F. K. Swett and James Hoare, to investigate the matter. The company has offered to sell the plant to the town for $100,000, which is $50,000 less than the cost of the system. The privilege of extending the option on the plant has been refused by the company.

RICHMOND, MAINE.—The Richmond Electric Light Company has been organized and the following officers elected: C. D. Newell, president; George Fish, vice-president; Hnry E. Houdlett, treasurer, and Henry C. Reed, clerk.

BRATTLEBORO, VT.—The citizens are considering the question of establishing a municipal electric light plant.

COLORADO CITY, COL.—Articles of incorporation have been filed for the Colorado City Power & Light Company with a capital stock of $35,000 by W. P. Epperson, M. V. Watson and others. The company proposes to develop the water power of Bear Creek to generate electricity.

DAYTONIA, FLA.—The electric light plant, and cold storage plant owned by the estate of Adam Schantz was destroyed by fire April 22. The electric plant was insured for $25,000.

DENVER, COL.—The Orchard Construction Company has filed articles of incorporation with a capital stock of $25,000. The company proposes to construct irrigating ditches, reservoirs and power plants near Palisades, at a cost of about $700,000.

PARK RIDGE, N. J.—The citizens on April 21 voted to issue $30,000 in bonds, the proceeds to be used for extensions and improvements to the municipal electric light plant.

LOUDON, TENN.—The City Council is considering the question of establishing a municipal electric lighting plant.

HENNING, TENN.—It is proposed to install an electric light plant and water works system in this town. Mr. Page, of Millington, is interested in the enterprise.

MT. AYR, IA.—Plans are being considered to establish an electric light plant in this town. A company has been formed by W. J. Bell and others to build the same.

PLAQUEMINE, LA.—It is reported that the plant and holdings of the Plaquemine Electric Light & Power Company have been purchased

by M. P. Conery, superintendent of the Consumers Electric Company, of New Orleans.

LEWISBURG, TENN.—Plans are being considered for the construction of a large electric light and power plant in this city. The plant will be located at Lillard's Mill on Duck River, 10 miles north of the city.

## Business Notes.

CEILING AND DESK FANS.—The Dayton Fan & Motor Company, Dayton, Ohio, has issued a well-illustrated catalogue covering direct-current and alternating-current ceiling and desk fans.

THE P. M. FLETCHER COMPANY, 32 Frankfort Street, New York, on April 23, changed its name to the Fletcher-Stanley Company, which will conduct the business carried on under the former name.

THE UNITED STATES STANDARD ELECTRICAL WORKS COMPANY, of Racine, Wis., has filed an amendment to its articles of incorporation, changing its name to the Standard Electric Works Company.

ELECTRIC LAMP FITTINGS.—Publication No. 563 of Verilys, Ltd., Aston, Birmingham, England, illustrates and describes artistic lamp fixtures for decorative purposes and substantial watertight fittings for use on ships and docks.

FIBRE CONDUIT.—The Fibre Conduit Company, Orangeburg, N. Y., has issued a neat folder dealing with conduit made of extremely compact wood-pulp, which is non-conductive, light in weight and practically imperishable.

MOTOR EQUIPMENT FOR RAILROAD SHOPS.—Bulletin No. 5910-I of the Western Electric Company, Chicago, Ill., is a well-illustrated publication giving much information concerning the motor equipments in various railroad shops.

AUTOMOBILE DEVICES, including clutches, reversing gears, brakes, speed-changing gears, axles, springs and chassis frames are illustrated and described in a catalogue issued by the Merchant & Evans Company, 517 Arch Street, Philadelphia, Pa.

BATTERY-TESTING INSTRUMENTS, consisting of pocket voltmeter, ammeters, voltmeters, spark-coil current indicators and miniature switchboard instruments, are treated in an illustrated catalogue of the Eldredge Electric Manufacturing Company, Springfield, Mass.

GREENAWAY SEPARATORS.—The Liberty Manufacturing Company, Pittsburg, Pa., has purchased the Greenaway Separator business from Greenaway & Company, of Detroit, Mich., and in the future will fill orders for steam, oil, ammonia and air separators manufactured under the Greenaway patents.

ENGLISH MANUFACTURING. — Spagnoletti, Limited, Goldhawk Road, London, who are known as experienced manufacturers with a large English and Colonial connection, are taking up the subject of manufacturing for Americans under the British patent law, which aims to cancel a patent if the protected article is not made exclusively in England. The effect of this law appears to be rather sweeping, and it is certain that many American manufacturers it would reach will desire to keep their patent rights intact.

THE SOUTHERN EXCHANGE COMPANY, of New York, makes a specialty of octagonal and square sawed yellow pine poles, and reports that the demand for poles of this class has increased over 100 per cent in the past three years. These poles are made to any size, base or top, and in lengths from 25 ft. to 65 ft. The butts are usually tarred 6 ft. from the base, or the entire pole is creosoted. Poles of this kind are desirable for trolley, electric light and telephone lines in towns or cities, where a shapely pole is favored.

CANADIAN CROCKER-WHEELER COMPANY, LTD.—One of the signs of returning confidence in the business situation is the organization of the Canadian Crocker-Wheeler Company, Ltd., for the manufacture and sale in Canada of the Crocker-Wheeler apparatus. Mr. F. E. Lovell, president of the new company, is a member of the old-established lumbering firm of H. Lovell & Sons, of Coaticooke, Que., who have extensive interests in mills and timber limits throughout the Province of Quebec. Russell A. Stinson and F. Jno. Bell, vice-president and secretary-treasurer, respectively, have been identified with the manufacturing, construction and sales ends of the electrical trade in Canada for the past 15 years, and are particularly well known in Montreal, where the head office of the company has recently been opened in the Street Railway Chambers, Place d'Armes Hill.

## DIRECTORY OF ELECTRICAL ASSOCIATIONS, SOCIETIES, ETC.

American Electro-Therapeutic Association. Secretary, Dr. Albert C. Geyser, Willis Ave., New York City. Next meeting in September.

American Electrochemical Society. Secretary, Prof. J. W. Richards, Lehigh University, South Bethlehem, Pa. Annual meeting Albany, N. Y., April 30, May 1 and 2.

American Institute of Electrical Engineers. Secretary, Ralph W. Pope, United Engineering Societies Building, 29 West 39th St., New York. Meetings, second Friday of each month, excepting June, July, August and September. Annual convention, Atlantic City, N. J., June 29-July 2.

American Street & Interurban Railway Engineering Association. Secretary, Walter S. Mower, London, Ont.

American Society of Mechanical Engineers. Secretary, Calvin W. Rice, United Engineering Societies Building, 29 West 39th St., New York. Spring meeting, Detroit, Mich., June 23, 24, 25 and 26.

American Society of Municipal Improvements. Secretary, A. Prescott Folwell, Room 512 Flatiron Building, New York. Next meeting at Atlantic City, N. J., October 13.

American Street & Interurban Railway Association. Secretary, B. V. Swenson, United Engineering Societies Building, 29 West 39th St., New York.

Association of Edison Illuminating Companies. Assistant Secretary, S. E. Mumford, Detroit, Mich.

Association of Electric Lighting Engineers of New England. Secretary, Wells E. Holmes, 308 Washington St., Newton, Mass. Annual meetings held in Boston, third Wednesday in March.

Association of Iron and Steel Electrical Engineers. Secretary, G. H. Winslow, National Tube Company, Pittsburg, Pa.

Association of Railway Telegraph Superintendents. Secretary, P. W. Drew, Room 511, Harvester Building, Chicago. Next meeting, Montreal, Que., June 24, 25 and 26, 1908.

Canadian Electrical Association. Secretary, T. S. Young, 104 Confederation Life Building, Toronto, Ont. Next meeting at Toronto, June 10, 11 and 12.

Canadian Street Railway Association. Secretary, Allan H. Royce, 48 King St., W., Toronto, Ont.

Central Electric Railway Association. Secretary, W. F. Mulholland, Indianapolis, Ind.

Chicago Electric Club. Secretary, S. M. McFedries, care J. L. Schureman & Co., Chicago.

Colorado Electric Light, Power & Railway Association. Secretary, John F. Dostal, 405 17th St., Denver, Col.

Electric Club of Cleveland. Secretary, Geo. L. Crosby, 1200 Schofield Building, Cleveland, Ohio.

Electrical Contractors' Association of New York State. Secretary, John P. Faure, 77 Water St., Ossining, N. Y.

Electrical Contractors' Association of State of Missouri. Secretary, Charles J. Sutter, 1220 Pine St., St. Louis, Mo.

Electrical Salesmen's Association. Secretary, Francis Raymond, 209 State Street, Room 1002, Chicago. Annual meeting, Chicago, January, each year.

Electrical Trades Association of Canada. Secretary, William R. Stavely, Royal Insurance Building, Montreal, Can.

Electrical Trades Association of Chicago. Secretary, Frederick P. Vose, Marquette Building, Chicago. Next meeting, Chicago, November 5.

Electrical Trades Association of Philadelphia. Secretary, E. A. Symmes, 810 Drexel Building, Philadelphia, Pa. Meetings, second and fourth Thursdays of each month.

Electrical Trades Association of the Pacific Coast. Secretary, Albert H. Elliott, Claus Spreckels Building, San Francisco, Cal. Monthly meetings, San Francisco, first Thursday of each month.

Electrical Trades Society of New York (Member National Electrical Trades Association). Secretary, Franz Neilson, 80 Wall St., New York. Board of Directors meets second Friday of each month.

Empire State Gas & Electric Association. Secretary, Charles H. B. Chapin, 154 Nassau St., New York. Next meeting in October.

Engine Builders' Association of the United States. Secretary, J. I. Lyle, 39 Cortlandt St., New York.

Illinois State Electric Association. Secretary, H. E. Chubbuck, La Salle, Ill.

Illuminating Engineering Society. Secretary, V. R. Lansingh, 33 West 39th St., New York. Sections in New York, New England, Philadelphia and Chicago.

Independent Electrical Contractors' Association of Greater New York. Secretary, Lewis H. Woods, Imperial Hotel, Broadway and Thirty-Second St., New York.

Independent Telephone Association of Southern Indiana. Secretary, E. W. Landgrebe, Huntingburg, Ind.

International Association of Municipal Electricians. Secretary, Frank P. Foster, Corning, N. Y. Next meeting, Detroit, Mich., 1908.

International Independent Telephone Association. Secretary, J. B. Ware, Grand Rapids, Mich.

Iowa Electrical Association. Secretary, W. N. Keiser, Des Moines, Ia.

Iowa Independent Telephone Association. Secretary, C. C. Deering, Boone, Ia.

Iowa Street & Interurban Association. Secretary, L. D. Mathes, Dubuque, Ia.

Kansas Gas, Water & Electric Light Association. Secretary, James D. Nicholson, Newton, Kan. Next meeting at Pittsburg, Kan., October 8 and 9.

Kentucky Independent Telephone Association. Secretary, James Maret, Mount Vernon, Ky. Regular meetings, second Tuesday in October each year.

MASSACHUSETTS STREET RAILWAY ASSOCIATION. Secretary, Charles S. Clark, 70 Kilby St., Boston, Mass. Meets second Wednesday of each month, except July and August.

MICHIGAN ELECTRICAL ASSOCIATION. Secretary, A. C. Marshall, Port Huron, Mich.

MINNESOTA ELECTRICAL ASSOCIATION. Secretary-Treasurer, Ludwig Kemper, Albert Lea, Minn.

MISSOURI INDEPENDENT TELEPHONE ASSOCIATION. Secretary, G. W. Schweer, Windsor, Mo. Next meeting, Kansas City, May 6 and 7.

MISSOURI ELECTRIC LIGHT, GAS & STREET RAILWAY ASSOCIATION. Secretary, C. Z. Pierson, St. Charles, Mo.

NATIONAL ARM, PIN & BRACKET ASSOCIATION. Secretary, J. B. Magers. Madison, Ind.

NATIONAL ELECTRIC LIGHT ASSOCIATION. Secretary, W. W. Freeman. Brooklyn Edison Company, Brooklyn, N. Y. Headquarters, 33 West 39th St., New York. Next meeting at Chicago, May 19, 20, 21 and 22, 1908.

NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION OF THE UNITED STATES. Secretary, W. H. Morton, 94 Genesee St., Utica, N. Y. Next meeting at Chicago, July 15.

NATIONAL ELECTRICAL TRADES ASSOCIATION. Secretary, Fred P. Vose, 1343 Marquette Building, Chicago. Next meeting at Philadelphia, June 11.

NEBRASKA ELECTRICAL ASSOCIATION. Secretary, William Bradford, Lincoln, Neb. Next meeting, Omaha, May 4 to 9.

NEW ENGLAND ELECTRICAL TRADES ASSOCIATION. Secretary, Alton F. Tupper, 84 State St., Boston, Mass. Directors meet first Wednesday of each month.

NEW ENGLAND STREET RAILWAY CLUB. Secretary, John J. Lane, 12 Pearl St., Boston, Mass. Meets last Thursday of each month.

NEW YORK ELECTRICAL SOCIETY. Secretary, G. H. Guy, 33 West 39th St., New York.

NEW YORK STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, R. M. Eaton, Niagara Falls, N. Y.

NORTHWESTERN ELECTRICAL ASSOCIATION. Secretary, Roger N. Kimball, Kenosha, Wis. Next meeting, Milwaukee, January, 1909.

OHIO ELECTRIC LIGHT ASSOCIATION. Secretary, D. L. Gaskill, Greenville, Ohio. Next meeting, Aug. 25, 26 and 27, 1908.

OHIO INDEPENDENT TELEPHONE ASSOCIATION. Secretary, Ralph Reamer, Columbus, Ohio.

OHIO SOCIETY OF MECHANICAL, ELECTRICAL & STEAM ENGINEERS. Secretary, F. W. Ballard, 104 Canal St., Cleveland, Ohio. Next meeting at Columbus, May 15 and 16.

OKLAHOMA ELECTRIC LIGHT, RAILWAY & GAS ASSOCIATION. Secretary, Galen Crow, Guthrie. Next meeting at Guthrie, May 25, 26 and 27.

OLD TIME TELEGRAPHERS' & HISTORICAL ASSOCIATION. Secretary, John Brant, 195 Broadway, New York. Next meeting, Niagara Falls.

PENNSYLVANIA STATE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, H. E. Bradley, 136 South Second St., Philadelphia, Pa.

PIKE'S PEAK POLYTECHNIC SOCIETY. Secretary, E. A. Sawyer, Colorado Springs, Col. Meeting second Saturday of each month.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Secretary, Arthur L. Williston, Pratt Institute, Brooklyn, N. Y.

SOUTH DAKOTA INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. R. Buck, Hudson, S. D.

SOUTHWESTERN ELECTRICAL & GAS ASSOCIATION. Secretary, R. B. Stichter, Dallas, Tex. Next meeting at El Paso, Tex., May 7, 8 and 9.

STREET RAILWAY ACCOUNTANTS' ASSOCIATION OF AMERICA. Secretary, E. M. White, Box 345, Hartford, Conn.

STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK. Secretary, J. H. Pardee, Canandaigua, N. Y.

VERMONT & NEW HAMPSHIRE INDEPENDENT TELEPHONE ASSOCIATION. Secretary, E. B. Seeley, St. Johnsbury, Vt.

VERMONT ELECTRICAL ASSOCIATION. Secretary, C. C. Wells, Middlebury, Vt.

UNDERWRITERS' NATIONAL ELECTRIC ASSOCIATION. Secretary, Electrical Committee, C. M. Goddard, 55 Kilby St., Boston, Mass.

WESTERN SOCIETY OF ENGINEERS. Electrical Section, formerly Chicago Electrical Association. Secretary, J. H. Warder, 1737 Monadnock Block, Chicago. Regular meetings, first Friday of each month, except January, July and August. Annual meeting, first Tuesday after Jan. 1 each year.

# Weekly Record of Electrical Patents

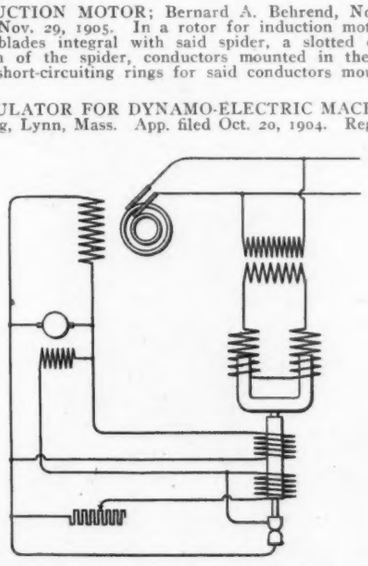
UNITED STATES PATENTS ISSUED APRIL 21, 1908.

[Conducted by Rosenbaum & Stockbridge, Pat. Attys., 41 Park Row, N. Y.]

885,007. TELEPHONE-TRANSMITTER; Alberta E. Beachum, Polkton, N. C. App. filed Aug. 7, 1907. A telephone transmitter including a diaphragm and a microphonic element comprising a vacuum tube connected to the diaphragm and extending parallel therefrom, said tube inclosing circuit terminals and a mass of conducting granules for bridging said terminals.

885,009. INDUCTION MOTOR; Bernard A. Behrend, Norwood, Ohio. App. filed Nov. 29, 1905. In a rotor for induction motors, a spider, radial fan-blades integral with said spider, a slotted core mounted on the rim of the spider, conductors mounted in the slots of the core, and short-circuiting rings for said conductors mounted on said fan-blades.

885,031. REGULATOR FOR DYNAMO-ELECTRIC MACHINES; Richard Fleming, Lynn, Mass. App. filed Oct. 20, 1904. Regulator having



885,031.—Regulator for Dynamo-Electric Machines.

a single continuously vibrating member acted on by a coil which is responsive to the voltage to be regulated. A second coil is provided in opposition to the first and short circuited by the vibration of said member.

885,034. TRANSFORMER; John J. Frank, Schenectady, N. Y. App. filed Sept. 26, 1907. A means for insulating the coils from one another so that the high voltage stresses to which the insulation is subjected may be better withstood. Has means for equalizing the potential stresses due to one of the windings over a large area of insulation between the windings.

885,054. GAS ELEMENT FOR CONVERTING THE ENERGY OF COMBUSTIBLE OR OTHER SUITABLE REDUCING SUBSTANCES TO ELECTRIC CURRENT; Ernest W. Jungner, Kneippbaden, Norrköping, Sweden, App. filed May 15, 1907. A galvanic gas element producing sulfuric acid comprising sulfurous acid, a suitable reducing substance and oxygen as a generating medium, and an electrolyte of sulfuric acid of such concentration as to be capable of reduction to sulfurous acid by reducing agents.

885,055. ERNEST C. KETCHUM, Boston, Mass. App. filed July 3, 1907. Has a car with a platform carrying a boiler and a steam turbine driving a generator. Also includes a form of radiator condenser at the front end of the car.

885,061. INTERLOCKING RELAY; Thomas L. Lee, Westfield, N. J. App. filed June 6, 1907. Relay for use in connection with an electrical apparatus in which it is necessary to arrange for automatically preventing the contemporaneous opening or closing of two or more circuits, for example, in connection with an electric alarm bell for signaling the approach of trains on a single track railroad. Makes use of a form of interlocking relay.

885,063. TROLLEY STAND; William A. Loudon, Chicago, Ill. App. filed Aug. 9, 1905. A trolley stand particularly adapted to mining locomotives and having a fixed vertical standard with a hinged pole which is impelled upward by a spring and plunger longitudinally movable within the standard.

885,083. ELECTROLYTIC APPARATUS; Brodde E. F. Rhodin, Sault Ste. Marie, Ontario, Canada. App. filed Oct. 30, 1906. A cell for electrolytic processes, having a series of concentric retaining ridges arranged stepwise, each of said ridges being separate from the others.

885,106. SYSTEM OF DISTRIBUTION; Lewis L. Tatum, Norwood, Ohio. App. filed Apr. 16, 1906. Multiple voltage system of distribution in which balancers are employed for maintaining the differences in voltage between the several conductors at their predetermined values when the currents in the various branches of the system are unbalanced or unequal.

885,121. PUNCTURE TELLTALE; Charles A. Winter, New York, N. Y. App. filed Aug. 14, 1906. The patentee has a spring-impelled plunger movable radially through the felly so as to engage the inner tube. In case the tire collapses this device moves to establish an alarm circuit.

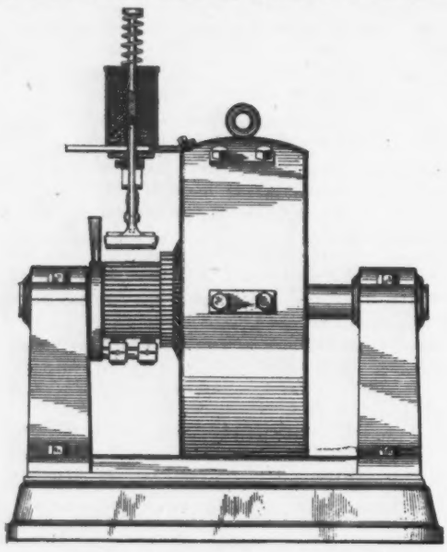
885,128. MOTOR CONTROL; Ernest F. W. Alexanderson, Schenectady, N. Y. App. filed Jan. 26, 1907. Relates to the control of commutator motors designed to be operated as series motors on direct currents and as repulsion motors on alternating currents. Provides a novel control system for such motors designed to avoid commutator troubles, and so arranged that the alternating current voltage may be made about twice that of the direct current without increasing the strain on the insulation of the motors.

885,134. ELECTRIC GAS LIGHTING MACHINE; David A. Barlow, Orange, Conn. App. filed Feb. 21, 1907. The patentee has a plurality of sliders with laterally projecting arms extending over the several burners. The sliders can be separately manipulated to ignite any burner.

885,143. AUTOMATIC SYNCHRONIZER; Frank Conrad, Swissvale, Pa. App filed Feb. 2, 1907. A means for automatically connecting an alternating current generator to a circuit when the currents generated thereby agree in phase and frequency with those in the circuit.

885,147. CONTROLLING DEVICE FOR ELECTRIC MOTORS; Charles A. Dresser, Chicago, Ill. App. filed Oct. 24, 1903. Particularly adapted for controlling motors in connection with any driven mechanism, particularly with motors for driving flat bed and other printing presses. Has a solenoid with a hollow core containing a contact bar, and which is prevented from moving under certain circumstances by a magnet-operated detent.

885,163. ARMATURE WINDING FOR HIGH SPEED DYNAMO ELECTRIC MACHINES; Benjamin G. Lamme, Pittsburg, Pa. App. filed June 2, 1905. Has a slotted armature core and a commutator cylinder and a winding comprising a plurality of coils located in the



885,278.—Commutator Wiper and Oiler.

armature slots. Includes conductors located in the armature slots for connecting the terminals of the coils with alternating commutator segments.

885,168. AUTOMATIC SIGNALING DEVICE; Guy Mulburn, Baltimore, Md. App. filed May 11, 1906. Relates to train signaling mechanism and provides a block system in which signals are automatically displayed in the cab of the locomotive by means of circuits which are completed between the different trucks of the train when the latter passes sectionally electrified track rails.

885,180. TELEPHONE TRUNKING SYSTEM; Edwin H. Rupe, Chicago, Ill. App. filed Nov. 15, 1906. In a telephone system, the combination with a cord circuit, of a ringing key, and a relay, the actuation of which depends upon the character of the jack with which the cord is connected, for governing the connection with said key, and jacks of different character with which the cord may be connected.

885,184. WINDING FOR DYNAMO ELECTRIC MACHINES; Walter Schmidt, Pittsburg, Pa. App. filed July 17, 1905. Provides a form of winding adapted to be applied to the rotatable core of an induction machine to occupy a minimum amount of space outside of the core slots. The winding comprises two groups of coils at right angles to one another and having end connectors which are disposed in two substantially parallel planes. Includes a plurality of insulating blocks for supporting the different groups of end connectors.

885,186. THREE-WIRE CENTRAL-ENERGY TELEPHONE SYSTEM; Charles A. Simpson, Chicago, Ill. App. filed Feb. 26, 1906. Includes complete diagram of cord, signal and testing circuits.

885,223. RECEIVER; Wiley T. Boyd, Ellenton, Fla. App. filed Feb. 12, 1907. The combination with a receiver provided with a removable cap, of divergent nipples projecting from said cap and communicating with the interior of the receiver, flexible tubes secured at one end to said nipples, rigid ear tubes secured to the other ends of said flexible tubes, and a ring embracing and movable on the flexible tubes and cooperating therewith to form flexible adjustable clamping means for the rigid ear tubes.

885,245. DEVICE FOR SEPARATING IRON PARTICLES FROM CHAFF AND THE LIKE BY MEANS OF MAGNETS; Joseph Hagmüller, Allensbach, Germany. App. filed Jan. 2, 1908. Includes a plurality of permanent magnets attached to the cutter arms adjacent to the blades so as to attract and hold the iron particles in the chaff.

885,270. TELEPHONE SYSTEM; Frank E. Mayberry, West Medford, and Newman H. Hollard, Brookline, Mass. App. filed April 12, 1902. Form of vibrator bell for telephone sets having a switch hook and a recorder associated therewith.

885,278. COMMUTATOR WIPER AND OILER; Daniel D. Neville, George H. Clay and John H. Clewer, Kansas City, Mo. App. filed Nov. 16, 1905. A commutator wiper and oiler designed to be applied to any dynamo and including a depressible frame carrying the wiping devices and which is lowered when required by the action of the solenoid.

885,338. ARC LAMP; Johannes Härden, Schenectady, N. Y. App. filed Dec. 12, 1903. In an alternating-current arc lamp having one electrode, which is freely depressible, the patentee provides a protecting hood for the combustible electro, so as to prevent its too rapid burning away in the atmosphere.

885,345. ELECTRIC SWITCH; Benjamin Hughes, of Montreal, and Herbert Noel Young, Rockfield, Quebec, Canada. App. filed Oct. 1, 1904. A complete track switch making use of magnets on the car which selectively attract amatures constituting a circuit controller and which act to selectively energize solenoids which move the switch point through a reciprocating plunger.

885,348. TELEPHONE-HOOK SWITCH; Herbert L. Knight, Cleveland, Ohio. App. filed April 13, 1906. Mechanical details of hook switch for desk telephones.

885,367. RAILWAY SIGNAL AND TELEPHONE SYSTEM; Frederick L. Odenbach, Cleveland, Ohio. App. filed July 10, 1907. In a railway signal system, the combination with a track rail, a line conductor, and a train unit provided with an electric generator, of a rotatable switch upon said train unit adapted to alternate the connection of said line conductor between said generator and said track rail and an electric signal device connected between said track rail and said generator, substantially as set forth.

885,368. ICE-CLEANER FOR TROLLEY POLES; Jacob M. Olinger, Springfield, Ohio. App. filed Nov. 23, 1906. In place of the usual trolley wheel, the patentee fixes a Y-shaped casting to the trolley pole and which has edges constituting cutters to scrape the ice off of the wire.

885,394. APPARATUS FOR CONVERTING DIRECT CURRENT INTO ALTERNATING CURRENT; Frederick F. Strong, Boston, Mass. App. filed Feb. 16, 1906. A revolving commutator appliance adapted to perodically cut resistance into and out of a circuit and reverse the polarity thereof, so that the direct current is transformed into approximately a true sinusoidal wave.

885,400. ELECTRIC ARC LAMP FOR ALTERNATING CURRENTS; Geza Szuk and Wenzel Hackl, of Budapest, Austria-Hungary. App. filed Feb. 24, 1904. Arc lamps designed for alternating currents in which a magnet coil is used for controlling the separation and feed of the carbons by means of an armature formed by a ring movable in the field of force of said magnet coil and connected with a clutch mechanism acting upon the upper carbon.

885,430. THERMO-ELECTRIC COUPLE; William H. Bristol, New York, N. Y. App. filed Dec. 27, 1907. A thermo-electric couple, the two elements of which consist of graphite.

885,446. CONTROLLER; Arthur T. Crocker, Schenectady, N. Y. App. filed Aug. 1, 1906. The master controller has a movable member which is preferably operated by means of a main solenoid, controlled in such a manner that the master controller may be operated step by step in either direction or be caused to return quickly to the off position at the will of the operator.

885,476. MOTOR CONTROLLING SYSTEM; Arthur E. Hogrebe and Victor O. Strobel, Philadelphia, Pa. App. filed Jan. 14, 1907. A controlling system for motors requiring to be frequently started and stopped and reversed, as, for instance, where a metal planer is operated by a reversing motor automatically controlled by the planer dogs to produce a slow cutting travel and fast backing travel for the table. The device can be applied to an ordinary planing machine.

885,519. ELECTRIC SIGNAL; John Rebar, Smithdale, Pa. App. filed Nov. 11, 1907. Electric signaling system for railway trains designed to provide a simple and inexpensive device whereby the engineer may be communicated with from convenient points throughout the length of the train. Has resiliently supported contacts carried by the car couplers and having a wiping frictional contact with one another.

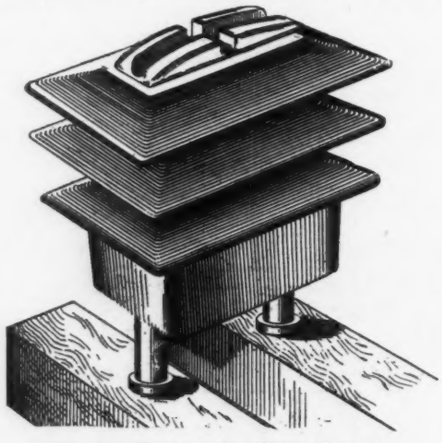
885,545. TELEGRAPH SOUNDER; James J. Thomas, Whiting, Iowa, and Albert G. Christopherson, Scribner, Neb. App. filed Jan. 23, 1907. The patentee has a pivotally mounted electromagnet the poles of which move toward and from the fixed poles of a permanent magnet. Is intended to be more sensitive than the present type of sounder.

885,562. SECONDARY BATTERY; William A. F. Alt, Brooklyn, N. Y. App. filed April 1, 1907. In a secondary battery, a plate of one sign, and a plurality of plates of the opposite sign, the aggregate area of said plurality of plates being substantially equal to the area of the single plate, means insulating the plates one from another, contact means carried by the plurality of plates adapted to engage like means, and means for separating the contact means.

885,622. PROCESS FOR OBTAINING PURE COPPER; Lucien Jumau, Paris, France. App. filed May 31, 1906. The herein-described process for obtaining pure copper from a solution containing salts of copper, which consists in treating said solution with a sulfite for producing a precipitate containing cuprous sulfite, and treating said cuprous sulfite with an acid to reduce a portion thereof to metallic copper.

885,631. HOUSING FOR ELECTRIC ALARM MECHANISM; James Blout Mayberry, Houston, Tex. App. filed Aug. 13, 1907. A semaphore signal for use on railways, making use of a housing containing batteries and alarm bells and designed to display an indication when a switch is thrown.

885,678. INSULATOR FOR HEAVY CURRENTS; Louis Steinberger, New York, N. Y. App. filed Jan. 26, 1906. In place of a single



885,678.—Insulator for Heavy Currents.

supporting pin for the insulator, the patentee makes use of a form having two supporting pins spaced apart in the direction of the line of strain of the conductor.

885,688. RELAY; Archibald S. Cubitt, Schenectady, N. Y. App. filed Aug. 24, 1907. Relay having current carrying coil and a core movable in the magnetic field thereof, and a frame serving as a path for the flux and as a magnetic shunt around said core. Includes means for varying the reluctance of the shunt path.

12,782. ELECTRIC HEATER; Moise Landry, San Francisco, Cal. App. filed Jan. 20, 1908. An electric heater comprising two parts hinged together and having an asbestos covering on their inner surface, and a high resistance wire arranged to lie between said coverings when the parts are closed.